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MODEL 610B

SWEPT FREQUENCY GENERATOR

INSTRUCTION MANUAL

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INSTRUCTION MANUALS ON PLUG-INS

FREQUENCY CONTROL, F1

This upper left hand knob sets the start frequency anywhere over the calibrated range of operation of the plug-in.

FREQUENCY CONTROL, F2

An upper right hand knob sets the stop frequency anywhere in the calibrated range of operation of the plug-in. F2 can be set at a higher frequency than F1 for sweeping upward in frequency or at a lower frequency than F1 for sweeping downward in frequency.

VARIABLE MARKER

Between F1 and F2, the marker control sets the frequency of the mark during sweep operation and is the center of the ΔF sweep during the ΔF mode of operation.

FREQUENCY SELECTOR

The major black knob control has six positions whose functions are listed below.

REMOTE. The frequency output is completely determined by the voltage applied on the remote frequency programing at the rear.

F1 TO F2. Frequency sweep between the limits programed by the knobs F1 and F2.

ΔF SWEEP Plus and minus around the variable marker frequency.

CW F1. A fixed frequency non-swept signal selected by the F1 control.

CW MARKER. A fixed frequency non-swept signal selected by the VAR. FREQ. MARKER control.

CW F2. A fixed frequency non-swept signal selected by the F2 control.

The inner red control of the FREQ. SELECTOR switch has two positions for RETRACE RF, ON or OFF. In the 'ON' position the R.F. signal remains on between sweeps. In the RETRACE 'OFF' position the R.F. stays off between sweeps.

ΔF FREQUENCY

The ΔF control sets a calibrated sweep of from 0 to 5% about a center frequency selected by the VAR. FREQ. MARKER control. For example, when set to "2" the frequency sweep would be ±1% of the total frequency spanned by the plug-in frequency range.

SWEEP MODE

This switch selects the manner in which the sweep is initiated. The four positions of the main outer control are listed below.

TRIG. A panel push button initiates a sweep so as to provide single sweep capability.

MANUAL. In this position there is no sweep and the frequency can be manually tuned by the inner red knob.

The inner red control is used to manually tune the frequency when the outer black knob is set at manual. This control will manually tune over the frequency range set by the F1 TO F2 CONTROL or by the ΔF FREQUENCY. During this manual tuning a horizontal output is supplied proportional to the percent of frequency excursion.

LINE SYNC. The switch for syncing at the 60 cycle line frequency. This is often useful in examining hum effects or other effects that are believed to be related to line frequency.

AUTO. The sweeps recur with a minimum delay between sweeps.

Functions of Controls - cont'd

SWEEP TIME (SEC)

The outer black control sets the range of sweep times to one of four ranges covering from 100 seconds per sweep to .01 seconds per sweep. The inner red knob selects the exact sweep desired in the 10:1 range. For example when the black knob is in the 100 - 10 position, the red knob provides a sweep greater than 100 seconds in its most counterclockwise position and a 10 second sweep duration in its most clockwise position.

FROM EXT. DETECTOR

This input provides the means of mixing the marker pips with the signal from an external detector and supplying their combined total to the VERT. OUT jack.

RF IN TO DETECTOR

This input goes into a crystal detector which can be used to detect the R.F. test signal out of the device under test. The output from this detector is on the VERT. OUT jack adjacent.

VERT. OUT

The VERT. OUT jack supplies the output from the built-in detector. This output is normally applied to the vertical axis of an oscilloscope or XY recorder.

HORIZ. OUT

The HORIZ. OUT provides the sweep voltage output of 0 to app. 10 volts sawtooth during F1 TO F2, ΔF, and MANUAL SWEEP MODES. 0 to approximately 10 v d.c. signal depending upon the frequency setting when operating at single frequency on F1 or F2. Output impedance is 10 K ohms.

MODULATION

NORMAL. The NORMAL position levels the R.F. output and permits no internal or external modulation.

INT. AM. The INTERNAL AM position actuates a built-in 1000 Hz amplitude modulation.

EXT AM. The internal leveling stays in operation and amplitude modulation is conducted by the input signal at the EXT. input BNC connector.

1 kHz FREQ. ADJ. Screwdriver control varies internal modulation frequency ±10% around 1 kHz.

EXT. FM. In the EXT. FM position the internal leveling remains on and the frequency is frequency modulated in accordance with the signal applied at the EXT. BNC connector. The input FM signal is internally coupled through approximately 0.1 microfarads capacitance. The input resistance is approximately 50 K ohms. The FM sensitivity is approximately 10 MHz per volt. The frequency response of the internal amplifier is approximately 30 Hz to 200 kHz. For external FM to be operative from this control the FREQ. SELECTOR switch must be in some position other than REMOTE. In the REMOTE position the frequency modulation would need to be conducted in conjunction with the frequency programing at the rear input terminals.

Function of Controls contd.

MODULATION continued

EXT. LEVELING. When the MODULATION control is in the EXT. LEVELING position the EXT. LEVELING sensitivity is adjustable by means of a screwdriver control directly above the EXT. LEVEL position. When the leveling is not being accomplished over the whole frequency band the unleveled light will come on. External leveling can be supplied by the user at the EXT. input BNC next to the LEVELING sensitivity control. A -100mv signal into 10 K ohms is a typical leveling input signal.

FREQUENCY MARKERS

A series of six toggle switches control the frequency markers. Each marker position can be separately turned on and off.

BIRDIE MARKERS AMPLITUDE

This control adjusts the amplitude of all birdie markers internal and external.

EXT. R. F. MARKER INPUT

An R.F. signal introduced on this BNC connector provides a frequency marker at the input frequency.

VAR. FREQ. MARKER AMP.

The inner red control adjusts the amplitude or intensity of the RF marker. The outer black control selects the type of marker, RF PIP (which achieves a notch marker by turning the RF off), VIDEO (which mixes pulse in video and does not disturb RF), and the INTENSITY (which causes an intensity mark on the output display scope.)

REAR TERMINAL CONNECTORS

110/220 VOLT SWITCH. Selects the line voltage to be used, 110 volts or 220 volts.

FUSE. 0.8 Amp. Slo-Blo, replaceable at rear next to power cord.

TRIGGER IN. Sweep can be triggered by +1 volt signal with greater than 1 μs pulse width and greater than 0.1 volt/μsec rise.

BLANKING. Output of +30 v during retrace. Near ground during sweep.

REMOTE FREQ. Terminal A has positive 10 volts output. Terminal D is grounded. Terminal B is the input which controls frequency. Zero volts on terminal B gives the lowest frequency of the plug-in range. Plus 10 volts gives the highest frequency of the plug-in range. Other terminations are made use of for external programing.

VERT. OUT. Optional BNC connectors can provide output from the built-in detector. This rear terminal is in parallel with the front panel connector.

HORIZ. OUT. Optional BNC connectors provide 10 volt sawtooth during sweep. The rear terminal is in parallel with front panel connector.

EXT. INPUT. EXT. INPUT is an optional BNC connector for applying AM or FM or EXT leveling depending on the position of front panel MODULATION switch. In parallel with front panel connector.

Function of Controls contd.

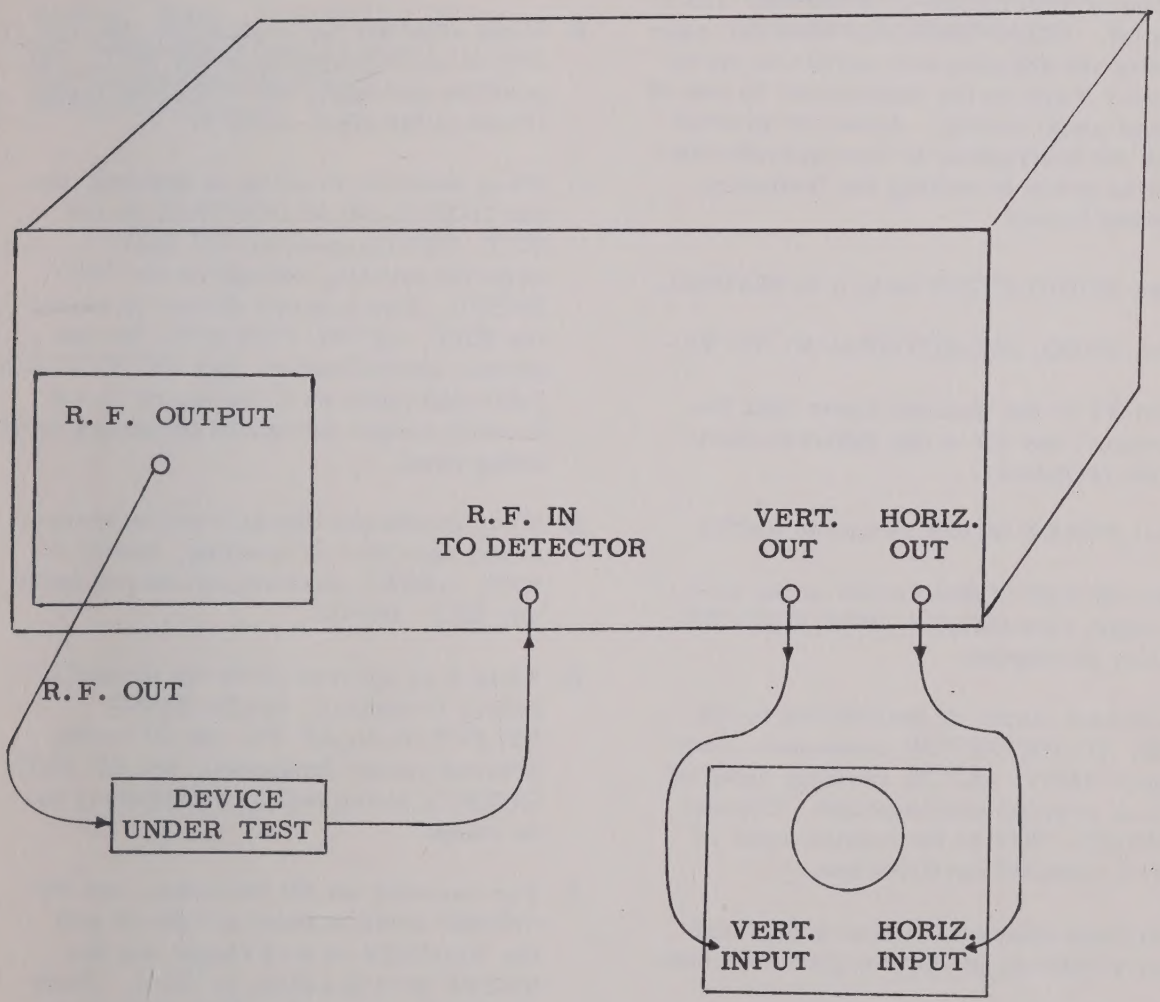
REAR TERMINAL CONNECTORS contd.

VARIABLE MARKER OUT. Optional output BNC provides a pulse out coincident in time with the variable marker.

PEN LIFT CONTACTS. Optional output provides contact closure during retrace to be used in lifting the pen of an XY recorder.

SECTION 3 MEASUREMENT PROCEDURE

Typical Measurement Setup for
Plotting the Amplitude Response vs Frequency
of a device under test



HOW TO PLOT FREQUENCY RESPONSE

The below step-by-step procedure is used for plotting the amplitude response of a device under test as a function of frequency.

1. Plug in power cord to 50-60 Hz, 115 v outlet. (Slider switch on the rear converts the transformer to 230 volt operation.) Turn on the instrument by use of front panel switch. Allow 30 minutes for the instrument to temperature stabilize prior to setting the frequency sweep limits.

2. Set MODULATION switch to NORMAL.

3. Set FREQ. SELECTOR to F1 TO F2.

4. Set F1 to the desired lower test frequency; set F2 to the desired upper test frequency.

5. Set SWEEP MODE switch to AUTO.

6. Set SWEEP TIME switch in the 10-1 range; turn SWEEP TIME VERNIER fully clockwise.

7. Connect output of test device to RF IN, TO DETECTOR connector. Connect VERT. OUT to vertical input of d.c. coupled oscilloscope. Connect HORIZ. OUT to horizontal input of d.c. coupled oscilloscope.

8. Actuate desired frequency markers by switching on their toggle switches.

9. Select desired test signal level by the RF POWER LEVEL controls on the plug-in panel. The maximum output is +13 dbm which equals 1 volt rms output into 50 ohms.

10. Connect RF OUTPUT of sweeper to input port of the device under test. Observe the output response on the oscilloscope.

VARIATIONS IN USE OF SWEEPER

A. When external FM is desired, put the MODULATION switch in the EXT. FM position and apply frequency modulation to the EXT. INPUT.

B. When external AM is desired, put the MODULATION switch in the EXT. AM position and apply the amplitude modulation to the EXT. INPUT.

C. When external leveling is desired, put the MODULATION CONTROL in the EXT. LEVEL position and apply a negative leveling voltage to the EXT. INPUT. Use a screw driver to adjust the EXT. LEVEL CONTROL for the proper leveled output. The UNLEVELED light will come on if the signal is not leveled across the whole frequency band being used.

D. When maximum signal level is desired at the sacrifice of leveling, switch to EXT. LEVEL position and do not apply any EXT. INPUT.

E. When it is desired to sweep around a center frequency, set the FREQ. SELECTOR to ΔF F1, set F1 to the desired center frequency, set ΔF FREQUENCY to the total ΔF frequency to be swept.

F. For use with an XY recorder, set the SWEEP TIME control to 100-10 and the VERNIER to mid range; set the SWEEP MODE switch to TRIG. Push the TRIG button when it is desired to actuate a sweep.

G. For external frequency programing, set the FREQ. SELECTOR to REMOTE and set the output frequency by one of the following two methods:

   1. Connect the voltage output from terminals 3 and 1 to the terminals

Variations in Use of Sweeper - cont'd.

of a potentiometer. Connect the resultant voltage output from the center top of the potentiometer to terminal 2 which sets the frequency. Note: Terminals 1, 2 and 3 are located on the rear chassis marked REMOTE FREQUENCY.

2. Connect a voltage waveform of from +1 to +10 volts between input (terminal 2) and ground (terminal 3). See Section 4 for complete directions.

SECTION 4 REMOTE FREQUENCY CONTROL and PROGRAMMING

The Model 610B has provision, via terminal strip J103 on the rear of the instrument, for two types of frequency control.

Terminal B provides direct coupled frequency control with about 1 Megohm input impedance. This input is uncoupled from terminal C and used when a voltage controlled signal source is desired; e.g., for phase lock, for remote control of frequency, or for injection of an external sweep.

The control relation is 0 to +10 volts relating to 0 to 100% of the frequency range of the plug-in being operated. Thus the Model 6104 100 MHz Plug-In has a control relation of 10 MHz per volt. In remote situations, well shielded leads and minimum ground loops are required to prevent FM.

For resistance control an internal d.c. voltage is provided at terminal A which provides 10.0 volts ±1% when loaded with 10 K ohms. For continuous control a 10 K pot. may be connected as shown in Figure 1(a). For stability and accuracy, a precision wire wound pot. with good linearity should be used.

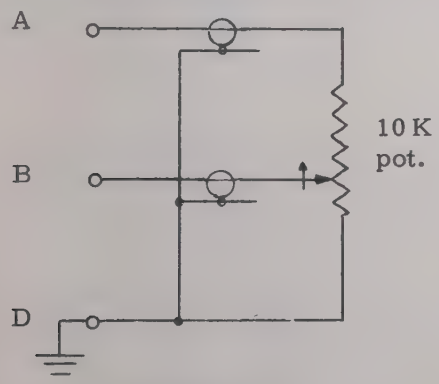
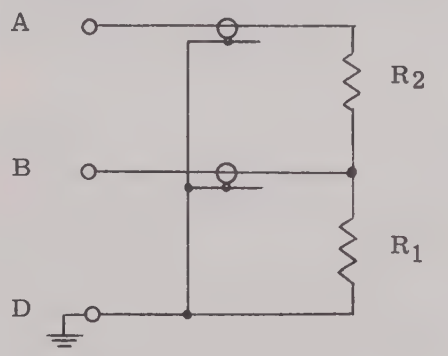


FIGURE 1(a)

By using a standard 10 turn pot. with the dial calibrated in decimal units the frequency will be direct reading for the Model 6104 Plug-In. A specific frequency can be established with fixed resistors as shown in Figure 1(b). For accuracy and stability, precision metal film or wirewound resistors should be used. Similarly, additional tap points along the 10 K total resistance and a selector switch connected to terminal B will provide multiple preset frequencies.



$R_1 = F \times 10\,K$ ohms

$R_2 = 10\,K - R_1$

where F is the desired frequency expressed in % of plug-in band.

FIGURE 1(b)

The other frequency control connection permits external programming of the Frequency Control circuit so that different frequency spans (up to 100% of the available band) and center frequencies may be established remotely. The internal sweep is used and two separate controls establish the center frequency, f_C, and the total frequency span, Δf. These controls function the same as the panel controls VARIABLE FREQUENCY MARKER and ΔF except that Δf is extended to permit a 100% sweep. Terminals B and C must be linked.

Remote Freq. Control... cont'd.

Both controls are linear so that full travel of each pot. relates to 100% of the frequency range of the plug-in being operated. The connections are shown in Figure 2 and the indicated resistance values of 50 K and 2 K must be observed for best performance.

The WILTRON Model 6111 Frequency Programmer provides 10 swept frequency programs selectable with a front panel switch. The unit connects to the rear of the Model 610B and each program is preset by the user to the desired frequency range.

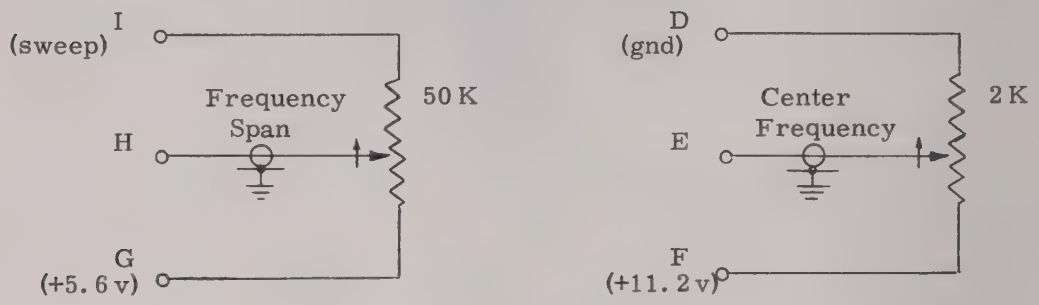


FIGURE 2

 (Pages 15 and 16 are blank)

6-1 GENERAL

The WILTRON Model 610B is a master support unit for various plug-in Frequency Generating Units. It supplies a standardized control voltage for setting frequency with calibrated sweep rates; level regulating circuits for maintaining a uniform output power level; modulation circuits; detection and frequency marker circuits; and stable regulated power supplies. Because of the broad frequency coverage of the various plug-ins different methods of frequency generation and level control are used. The following theory of operation describes generalized characteristics of the plug-ins with specific refinements referred to in the Theory of Operation Section for each plug-in.

6-2 SWEEP GENERATOR

The basic elements of the SWEEP GENERATOR are shown in Fig. 6A. The Miller Integrator consists of the amplifier Q104, Q105, Q106, the feedback capacitor C_T, and the charging current i_t set by R_T and -E. The Integrator is controlled by the state of the Schmitt Trigger via CR105 and R116. The output of the integrator is attenuated and voltage offset by the resistive divider and coupled through Q107 and R108 to the Schmitt Trigger input.

A sweep is initiated when Q103 turns on and opens CR105. The current i_t must now be supplied by C_T and a voltage linearly increasing with time begins developing across C_T. The high gain amplifier Q104, Q105, Q106 provides this same voltage so that the input to the amplifier remains essentially constant in voltage level. The charging current i_t is then constant and the voltage at the output of the amplifier is a linear ramp with time.

Sweep Generator- cont'd.

The ramp continues until the portion of it coupled back to the input of the Schmitt Trigger reaches the upper hysterysis level (UHL) and causes a change of state. With Q103 off, CR105 closes and R116 provides a current of about seven times i_t. The integrating process now reverses and C_T charges negatively (in a linear manner) at about six times its charge rate. This continues until CR104 closes and drains the current excess above i_t. This causes the output to cease movement and establishes a stable starting level for each sweep.

Fig. 6B shows the generated sweep voltage and the emitter voltage of Q107 which controls the Schmitt Trigger. This timing waveform shows how the emitter of Q107 is picked up at t_2, carried up with the ramp until it reaches the UHL causing the ramp to reverse at t_3, and falls along the slower time constant of R_{Ho} C_{Ho} until the LHL is crossed at t_5 causing another sweep to initiate.

By raising the clamp voltage on CR106 the emitter of Q107 can be prevented from reaching the LHL and the sweep cycle will cease and wait. This is the triggered mode and the waveform is shown in Fig. 6C. Refer to the full schematic 610B-100. Q101A and Q101B form a Schmitt Trigger which gives a uniform output for all input signals exceeding 1 volt. C103 differentiates this into a trigger pulse and CR102 and CR103 couple only the negative trigger through C104 to the input of Q102. If the sweep is in a recovered state the trigger will cross the LHL and initiate a sweep cycle, eg t_1, and t_5 in Fig. 6C. Manual triggering is accomplished with S103 which discharges the hold-off capacitor when pressed.

Sweep Generator - cont'd.

Upon release the discharged capacitor pulls the emitter of Q107 negative causing the LHL to be crossed and the sweep to start.

Transistors Q108 and Q109 are on during the sweep and off otherwise giving at J102 a voltage near zero during the sweep and +30 volts otherwise. This can be used for timing or blanking other equipment synchronous with the sweep. The voltage from Q111 is +28 volts during the sweep, near zero volts otherwise and is used to deactivate both the RF source and the level loop during the blanking period.

The Sweep Vernier, R134, is normally returned to about -18 volts and reduces the sweep rate by at least 10 to 1 as the voltage is reduced. The Field Effect Transistor, Q104, provides a very high input impedance so that slow sweeps can be achieved with reasonable sized capacitors. The Sweep Bias Adjustment, R126, corrects for the FET bias so that with zero volts on the sweep vernier the ramp will continue to move forward at a very slow rate. This permits intensification of an oscilloscope display by causing the spot to dwell for a period. The Variable Marker circuit, schematic 610B-300, provides the sweep vernier voltage and drops it to -5.0 when intensification is required.

In MANUAL SWEEP mode, R144 provides the sweeping voltage to following circuits and S101B2 forces both Q102 and Q103 to be off. This keeps the integrator at its starting point and sets all blanking outputs as if the sweep were on.

6-3 FREQUENCY INSTRUCTION

The sweep voltage from S101 is clamped between two reference voltages for the purpose of establishing accurately the levels traversed by the sweep and to create a short dwell period at each end for the circuits to respond to the blanking signals. See Fig. 6D. The upper end is clamped to the +11.2 supply voltage and the lower end to a voltage equal to the forward drops of CR202 and Q201. Each clamp voltage is adjustable and temperature compensated so that the output of Q201 can be set to traverse from zero to the voltage of the +11.2 supply which is within 5% of the stated value.

The truncated sweep voltage is attenuated to 0 to 10 volts and supplied as the Horizontal Output. It also drive the two potentiometers for setting F1 and F2. The current variations on the +11.2 volt supply caused by the sweep are cancelled by the action of Q202 which provides an equal and opposite variation. Since the 11.2 volt supply is the reference for both +30 and -20 this sweep ripple correction is apparent on all supplies.

Fig. 6D shows the connections between the frequency controls and the differential amplifier Q203, 4, 5 for F1 to F2 operation. The transistors Q204 and 5 are current sources for the amplifier. The amplifier output is 0 to +10 volts for a 0 to 100% of dial frequency sweep. The output can be represented as $10[x+(y-x)F_{(t)}]$ where x and y are the percent of full dial settings of F1 and F2 respectively and $F_{(t)}$ represents a 0 to 1 linear sweep function. The diagrams of Fig. 6E show the operation of this differential amplifier graphically. Note that if F1 is set above F2 the circuit functions as before and the output travels from the higher to lower value.

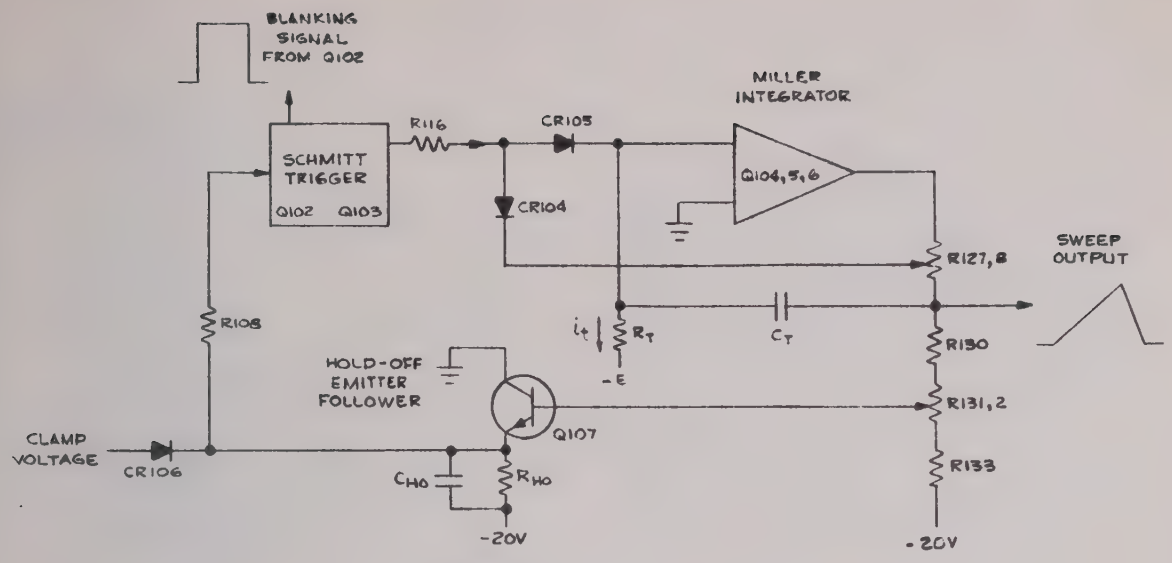


Figure 6A

BASIC ELEMENTS OF THE SWEEP GENERATOR

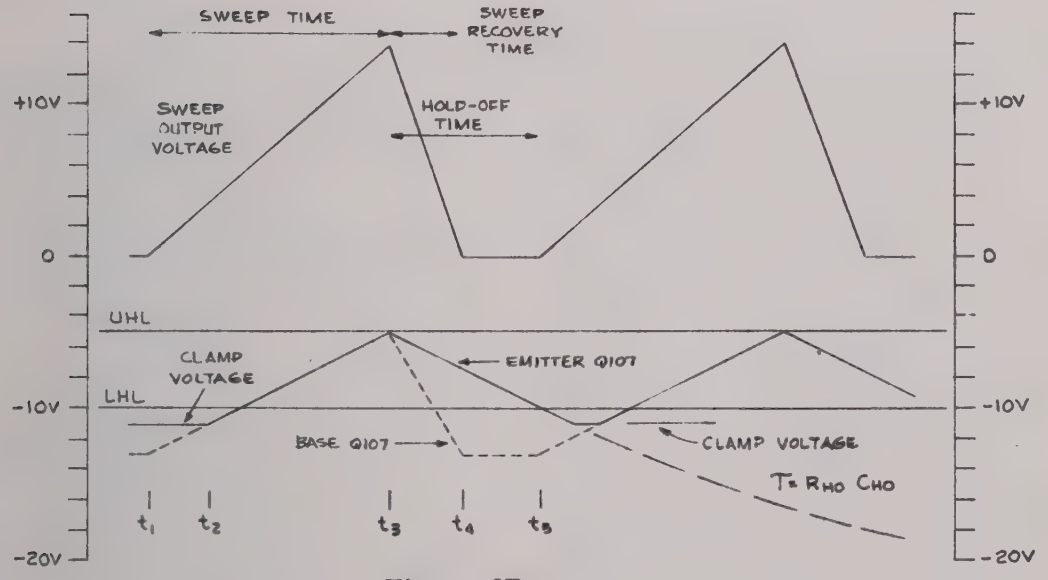


Figure 6B

FREE RUNNING SWEEP WAVEFORMS

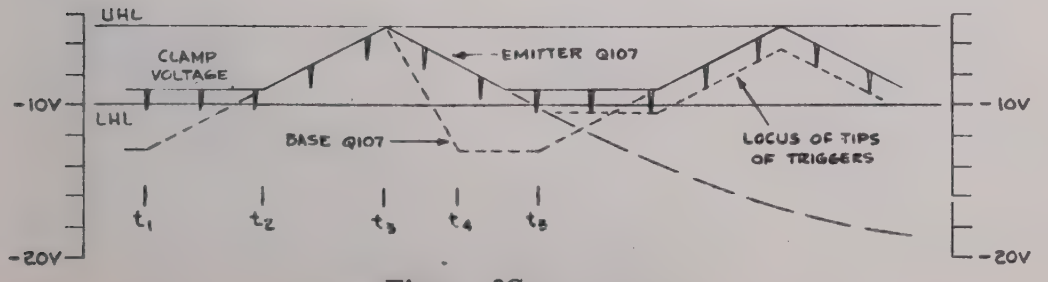


Figure 6C

TRIGGERED SWEEP WAVEFORMS

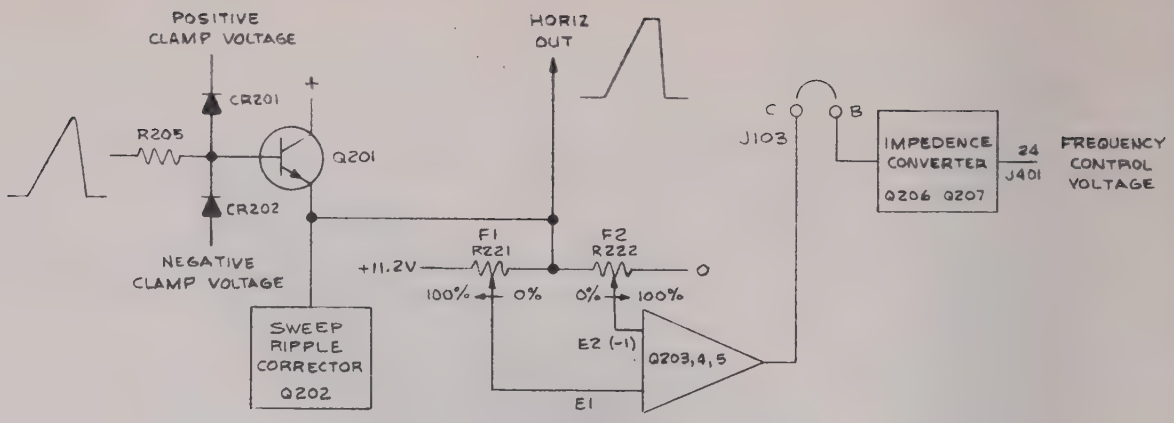


Figure 6D

FREQUENCY INSTRUCTION BASIC CIRCUIT

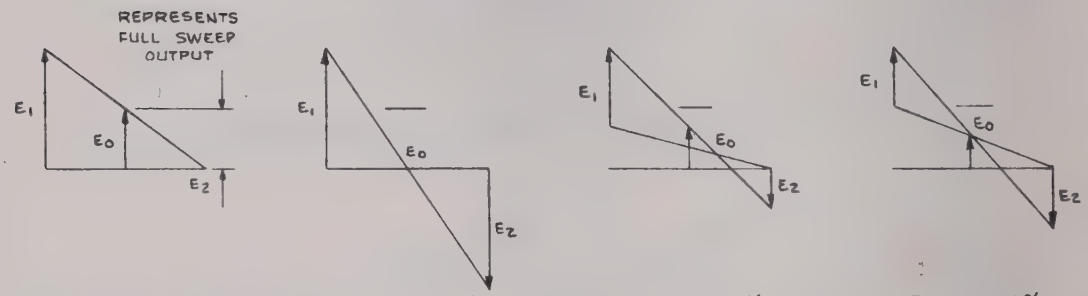


Figure 6E

FREQUENCY INSTRUCTION SUMMING DIAGRAMS

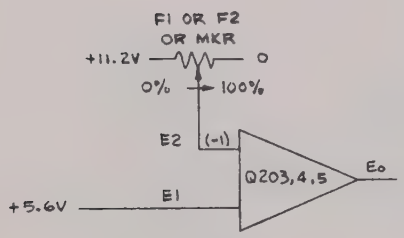


Figure 6F-1

FREQUENCY INSTRUCTION
CW OPERATION

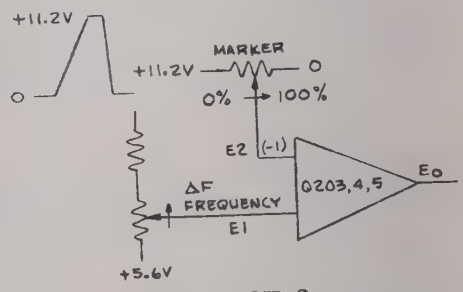


Figure 6F-2

FREQUENCY INSTRUCTION
ΔF OPERATION

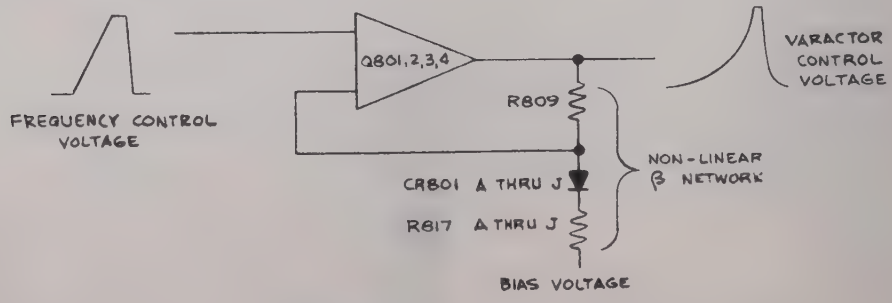


Figure 6G

FREQUENCY CONTROL BASIC CIRCUIT

Frequency Instruction - cont'd.

CW operation is similar with the appropriate Frequency Control providing a voltage proportional to the dial setting for one input and +5.6 (one-half of the 11.2 volt supply) connected to the other input. The Selector switch, S2-1B2, changes the two current sources, Q204 and Q205, to correct for a 5 volt offset in the output voltage which would otherwise occur. Figure 6F1 shows the CW connection and Fig. 6F2 shows the ΔF operation. ΔF functions the same as CW except that the +5.6 voltage is caused to sweep equal amounts above and below in proportion to the ΔF Frequency control setting. The calibration is in percent of full dial.

The Remote position of the Frequency Selector Switch connects the circuit for ΔF operation with connections to the rear terminal strip J103 where two potentiometers may be connected. See section
These controls function the same as the panel controls ΔF Frequency and Marker; however, ΔF can now be set for any sweep span up to the full capability of the plug-in use.

The 0 to 10 volt output of the Frequency Instruction circuit is wired to Terminal C of J103, back in term B and through the Impedance Converter Q206, 207. This circuit is adjusted for no voltage offset and has 98% transmission. This voltage feeds the Frequency Control circuits of the Plug-in and the Variable Frequency Marker circuit. The link is removable from terminal B of J103 so that an external voltage may be introduced for remote control frequency. Resistance control may also be used by using Terminal A. A 10K potentiometer connected from A to ground will have 10 volts across it and with its slider connected to terminal B will have direct frequency proportional to the potentiometer setting. A 1K value may be used by opening R219.

FM is obtained by coupling the external ac signal through C202 and R217 to the Frequency Control signal. Since the output frequency is directly proportional to this voltage the FM deviation will be essentially constant across the full band of the plug-in. When using Ext. FM together with remote frequency control on terminal B the impedance connected to terminal B should be raised to near 50K ohms by adding a series resistor to aid the coupling of low frequency FM signals.

6-4 FREQUENCY CONTROL

This section is a generalized discussion of the shaping circuit used with the varactor tuned oscillators. The theory of Operation section for the particular Plug-in will note any deviations. See Figure 6G for the basic circuit configuration.

The linear control voltage is fed to one input of the operational amplifier formed by Q803, 4, 1 and 2. The ouput is attenuated and fed to the other input. This negative feedback causes the gain of the amplifier to be the inverse of the attenuator characteristic. The attenuator is made non-linear by means of (typically) ten diodes each biased at a voltage between 0 and +10 volts. As the control voltage reaches each of the bias levels the corresponding diode starts to conduct lowering the impedance level of the lower part of the attenuator. Thus the output voltage changes to a steeper slope until the next diode closes. The resultant output voltage is composed of eleven straight line segments that very closely synthesize the non-linear varactor tuning voltage. The different bias voltages for the shaping diodes set the frequency where bending commences and the series resistance, R817, establishes the slope.
The ten resistances of R817 are selected for the particular oscillator in the plug-in.

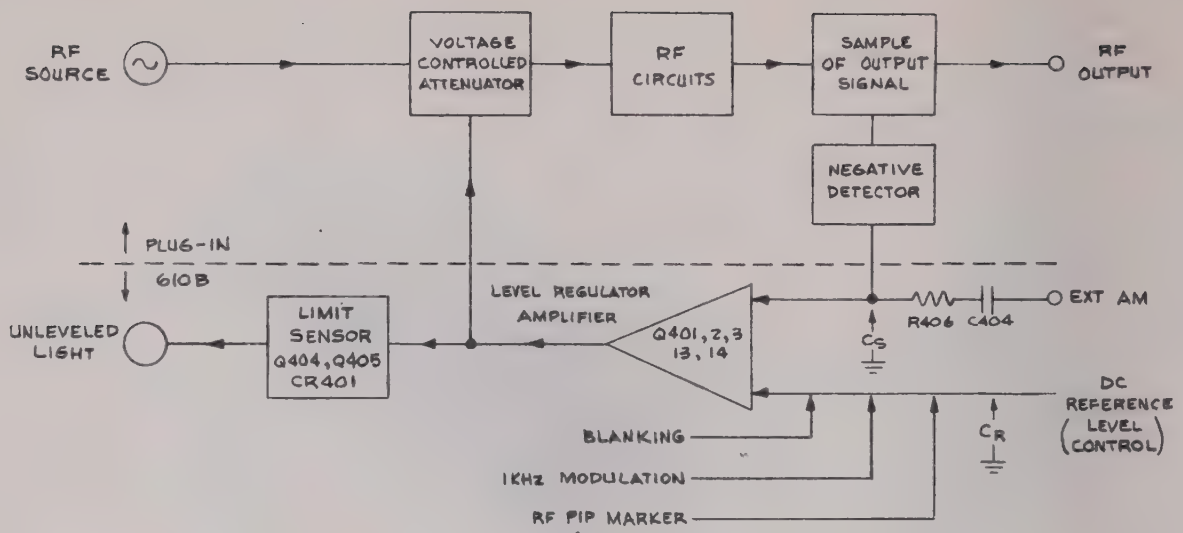


Figure 6H

LEVEL CONTROL BASIC CIRCUITS

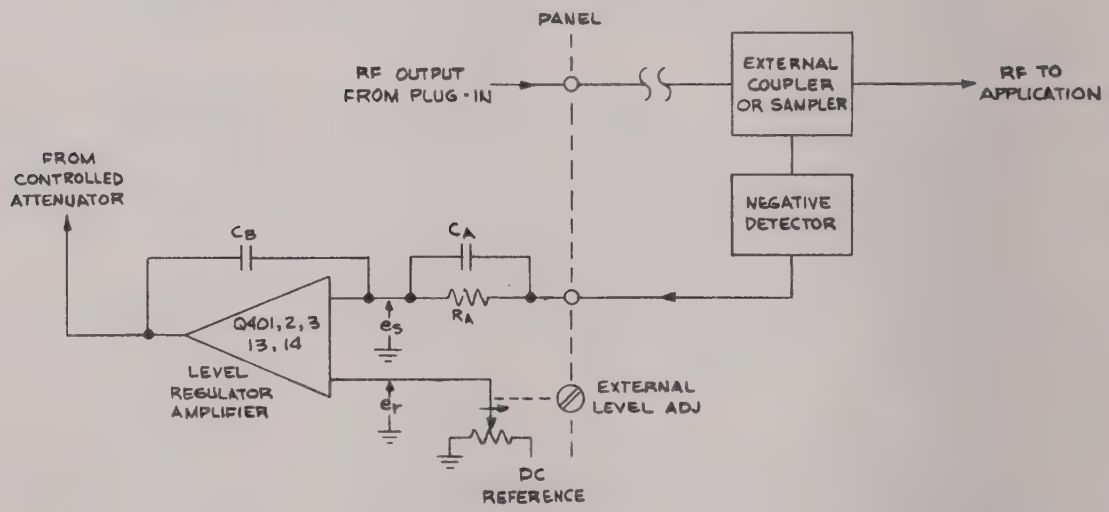


Figure 6I

EXTERNAL LEVELING BASIC CIRCUITS

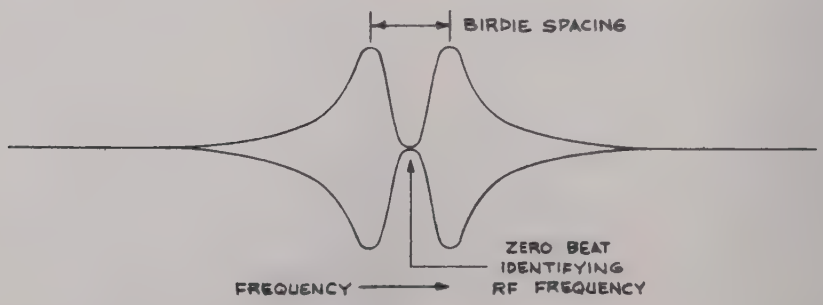


Figure 6J

BIRDIE MARKER ENVELOPE

6-5 OUTPUT LEVELING

The output signal is maintained level by monitoring and using electrical feedback to a voltage controlled attenuator. This same circuit is used to apply amplitude modulation to the signal.

The basic circuit configuration is shown in Fig. 6H. A fraction of the output signal is taken by the sampler which in many plug-ins is a coupler. This signal is converted to negative dc voltage e_s with a flat frequency response detector. A high gain operational amplifier compares e_s with a reference voltage e_r and delivers a suitable drive to the voltage controlled attenuator to make e_s equal e_r. With this control loop operating the output signal will be as flat as the characteristics of the sampler and the detector.

External amplitude modulation is accomplished by summing the modulation signal with the detector output to provide e_s. The inverted modulation signal is imposed upon the R. F. signal so that the sum of the detected R. F. plus the modulation signal equals e_r. It is apparent that sine wave modulation requires increased output at the peaks so that e_r, established by the Level Control, must be reduced to stay within the power output rating of the plug-in.

Internal modulation is accomplished with the 1 kHz square wave applied to e_r causing the detected R. F. to follow the instantaneous value of e_r. The 1 kHz oscillator is a free-running multivibrator, Q406 and Q407, with the output taken through CR404. The pulse from the variable frequency marker is also applied to e_r to cause a momentary dip in the R. F. level.

Output Leveling - cont'd.

When the RETRACE R. F. is turned off the blanking + signal pulls e_r to ground potential or slightly positive so that the voltage controlled attenuator is held in a high attenuation state during the retrace time when the R. F. signal is absent.

Whenever level control cannot be maintained the feedback loop will force the output of the amplifier to either its positive or negative extreme. At its positive limit (about +1. 5 volts) CR401 conducts and Q405 activates the Unleveled Light. At the negative limit (about -18 volts) Q404 is turned off and the light is powered. The blanking-signal is used to deactivate Q405 when the Retrace RF is off.

External leveling connections are shown in Fig. 6I. The elements $C_A R_A$ and C_B control the loop response to maintain stability and are a part of the plug-in. With crystal leveling a negative detector must be used. The External Level screwdriver adjust varies the dc reference to mate to the sensitivity of the external detector and acts as a level control. Detector voltages below 50 mv will give leveling but large larger voltages will give flatter performance because of higher loop gain. In the Power Meter position of the Modulation selector a 1K resistor is provided across the input terminal to satisfy the load requirement of a typical power meter. In addition the stabilizing network is changed to accommodate the very slow response time of the power meter.

6-6 INTERNAL DETECTOR

Schematic 610B-300 shows the internal detector composed of CR308, R313 and

* In addition, the 1 kHz square wave and the Blanking - signal are applied directly to the RF source to insure 100% AM modulation on INT AM and zero RF output during blanked retrace.

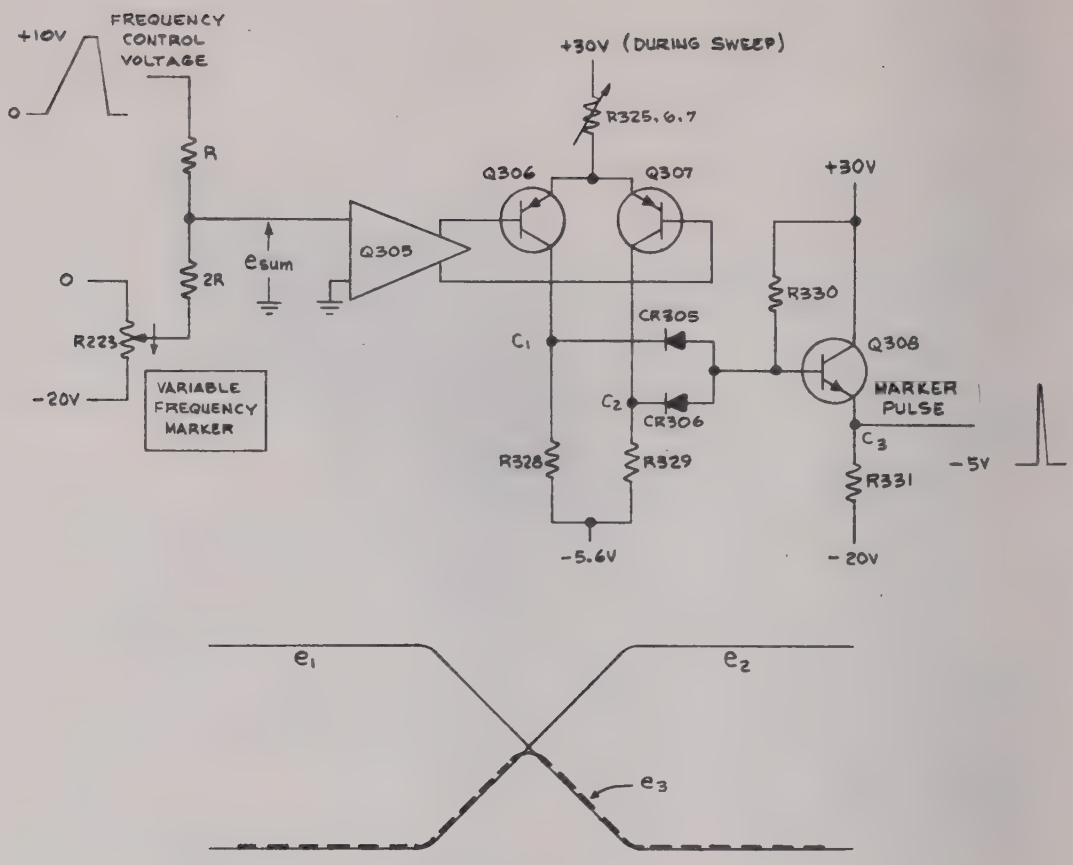


Figure 6K

VARIABLE MARKER COMPARATOR and PULSE SHAPER

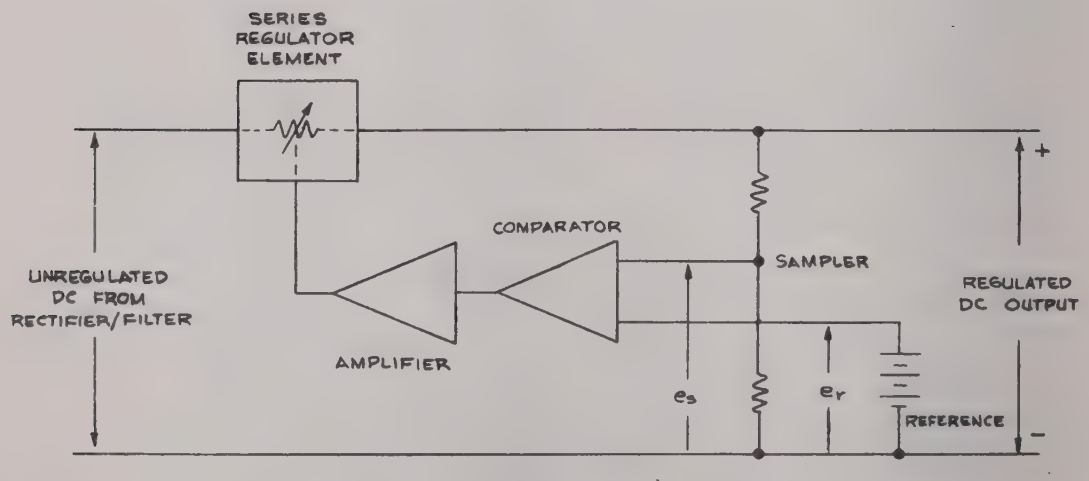


Figure 6L

BASIC POWER SUPPLY REGULATOR

Internal Detector - cont'd.

C310. The circuit is in a configuration which holds the flatness, VSWR and sensitivity good from 50 KH_Z to over GH_Z. The output of the detector is coupled through R315 to the Vertical Output jack. Provision is made for coupling the output of an external detector to the same jack.

6-7 MARKERS

Two marker systems are a part of the Model 610B; the Birdie Markers and the Variable Frequency Marker. The characteristic double peaked response of the birdie marker, see Fig. 6J, is coupled to the Vertical Output jack for display on the detected R. F. During retrace time Q304 shorts out the birdie signal to provide a clean base line. See Schematic 610B-300. The Variable Frequency marker (VFM) provides an identifying mark on the display for a dial setting. The output of the VFM is a positive going pulse which is coupled through the amplifier Q303 to place a narrow negative notch on the detector output when the VFM switch is in the Video position. In the R. F. Pip position the pulse is coupled through CR307 to momentarily drop the level reference voltage causing the R. F. output to dip. In the intensity position the display is brightening of the oscilloscope trace by the amplifier Q309 and 310 acting to slow the sweep progress momentarily thus permitting the electron beam to dwell and produce a brighter spot. This intensification is also present when the R. F. Pip and Video positions are used.

The Variable Frequency Marker functions with all plug-ins using the basic circuit as shown in Fig. 6K. The resistors R and 2R sum two voltages of opposite polarity, the frequency control voltage and a dc voltage proportional to the marker dial setting. The sum, e_S is zero when the Frequency Control voltage corresponds to the marker setting. The comparitor Q305 is a stable hi-gain linear amplifier which is followed by a differential amplifier Q306, 307. As the sweeping Frequency Control voltage causes e sum to cross zero the current in the differential amplifier makes a linear transition from Q306 to Q307. The collector voltage e_2, shown in Fig. 6K moves from -5.6 to a more positive value set by R329 and R325, 6, 7. The voltage e_1 simultaneously makes the opposite transition. The diode logic of CR304 and 306 couples the more negative of the two waveforms to the emitter follower, Q308, which thus shapes the variable marker pulse. By changing the available current with R326 the magnitude of the pulse is controlled. The high gain employed produces a very narrow marker only 0.4% of the dial width at its base for full amplitude and becomes more narrow with reduced amplitude.

Control of the sweep rate by the marker for instensity display is accomplished with Q309 and 310. These transistors form an amplifier with dc offset which provides the voltage for the Sweep Vernier control. The normal level is -18 volts which drops to -0.5 during the marker when the amplitude is at maximum. This reduces the sweep charging current causing the sweep to slow as the marker shape is generated.

The birdie markers are derived from the mixer shown on schematic 610B-001. All the plug-ins have internal provision for feeding a part of the output R. F. to this mixer to provide birdie markers. This internal R. F. is mixed with R. F. from up to seven single frequency oscillators, a harmonic train of R. F. frequencies or external R. F. applied at the front panel. The diode CR11 provides the non-linear mixing action and the beat frequency is brought out through the filter C11 and R32.

Markers - cont'd.

The beat frequency is enlarged and shaped by the tuned amplifier Q301, schematic 610B-300, to give the typical birdie shape shown in Fig. 6J. This amplifier is single tuned giving a response peak at its center frequency. The biridie has two peaks since it crosses the amplifier response twice; as the sweeping R. F. approaches the marker from below and again as it passes beyond. The spacing between peaks is 14 KH_Z in the Narrow position and 200 KH_Z in the Wide. The tuned circuitL302 and C304 sets the wide response. In narrow operation the tuned circuit L301, C303 and R308 is followed by a filter section R356 and C304 to make the birdie fall off faster with frequency, giving a more narrow response than a single tuned circuit. An untuned amplifier Q302 gives further magnitude which is controlled for display with the Marker Amplitude attenuator, R311.

Two marker widths are provided for usage with both wide and narrow sweeps. The wide marker should always be used when sweep width permits because it receives greater energy and typically produces a larger marker. The markers will improve in appearance when slower or narrower sweeps are used because the transition rate in MH_Z/sec through the birdie amplifier spectrum is reduced permitting the birdie envelope to contain more cycles of beat frequency energy.

The Harmonic Marker Generator accessory which fits into the 610B frame contains four crystal oscillators which are coupled through two buffer amplifiers to a step recovery diode. Only one oscillator is biased on the dc current which is overcome with the R. F. drive signal. During the reverse bias period the diode continues to conduct as the stored charge is swept out.

This reverse current suddenly drops to zero because of the particular doping of the junction, creating a sharp voltage step which is rich in harmonics of the R. F. drive signal. The diode voltage is coupled to the output 50 ohm coax. The generator that provides the fundamental frequency is a 1 MHz crystal oscillator. The multivibrator provides the necessary rapid drive signal for the step-recovery diode.

The SINGLE FREQUENCY MARKER unit consists of a crystal oscillator and an emitter follower. The output is lightly coupled to a 50 ohm coaxial line which passes through the unit. Successive units are connected in series with a 50 ohm termination on the last and the first connected to the birdie mixer.

6-8 POWER SUPPLIES

The two primary supplies are +30 and -20 volt and are designed for low ripple and high stability in the presence of temperature variations. Both supplies are fed by a bridge rectifier with a capacitor filter and follow the basic regulator circuit shown in Fig. 6L. The output voltage is sampled by a resistive voltage divider and is compared to a voltage reference. A differential amplifier is used for a comparitor so that temperature effects are cancelled. Any difference voltage between e_s and e_r is sensed by the comparitor and amplified. Another amplifier provides further gain to drive the series regulator element which completes the feedback loop. The series element changes its conductance until e_s is equal to e_r. Note that the negative output terminal may be grounded to make a positive supply or the positive supply or the positive terminal grounded for a negative output. Also e_s and e_r may be referenced to the positive lead with the amplifier output phase inverted to retain the negative feedback.

Power Supplies - cont'd

The +30V supply obtains its sample with R510 and R513 which is compared by Q506 to the reference +11.2V Super Regulated Power Supply. The amplifier, Q503 and 504, provides high gain for tight regulation and C508, R514 provide frequency compensation to maintain the loop stable. The driver transistor Q502 provides the current gain for controlling Q501 the series regulator transistor.

Current limiting to protect against short circuit overload is provided by R503, 504, and 508. When shorted the proper action of the regulator is to turn on Q503 to provide the short circuit currents. The voltage drop across R503 is proportional to this current and cannot exceed the drop across R504 because of the control of Q502. This drop is limited to the available current from Q503 which is set by R508. Thus the short circuit current is limited and Q501 is protected against excessive dissipation. The diode CR509 compensates for the base-emitter drop of Q502 to maintain the current limiting uniform with changing temperature.

The -20V supply works in the same manner as the +30V supply. It is referenced from the -6.2V ±5% Temperature, compensated zener diode, CR519.

The +11.2V Super Regulated Power Supply is referenced from CR521, a +6.2V ±5% temperature compensated zener diode. R539 and R540 provide the supply sample that is compared to the zener diode voltage. Loop gain for the +11.2V supply regulator is obtained from a μa 709 integrated circuit operational amplifier, Q506. The output of Q506 controls the current through Q512 the series device for the +11.2V supply.

R543 provides current limiting protection for Q512 in case of a short circuit or a current overload on the +11.2 supply buss. CR523 protects the inputs of Q506 from excessive offset voltages which could damage the integrated circuit.

The +5.6V supply is referenced from the +11.2V supply by R544, 545, and 546. The series device Q513 is driven by a differential amplifier consisting of Q514 and Q515. R547,548 and 549 provide current limit protection for Q513 in a manner similar to that described above for the +30V supply.

The -5.6V supply is provided by an emitter follower referenced from the -20V supply. CR520 compensates the reference divider for changes in the emitter to base voltage of Q516 with temperature and helps to maintain a -5.6V output with changes in temperature constant.

The high voltage power supply sets on top of the +30V supply and is programmed by the plug-in in use to provide between +40 and +140V with respect to ground. The comparator-amplifier Q411, 412 has +30V for its reference and the sampler is composed of R443, 444 and R801 in the plug-in. The driver transistor is composed of Q408 and Q409 in series to achieve a high voltage rating. The series transistor, Q410, will regulate up to 40 milliamperes at any output voltage between 40 and 140 volts. Frequency roll-off to control the feedback loop stability is provided by C412. Short circuit protection is established by R435, 439 and 445 in the same manner as the other supplies.

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SECTION 7

RECALIBRATION PROCEDURE

MODEL 610B

In this procedure it is assumed that the circuits being recalibrated are functioning. If the circuits are inoperative or operating improperly, refer to Section 7-17 for a recommended trouble shooting procedure. As an aid in trouble shooting the 610B, a simplified signal flow diagram is given at the beginning of Section 7-17. This diagram shows the major signal flow route in the 610B and indicates the key waveforms that should be used in isolating a problem to a particular stage.

The below Sections 7-1 through 7-6 are sequential and should be followed in that order. Make all tests and adjustments with a plug-in unit installed. Remove the top dust cover of the 610B for access to the printed circuit card socket test points. Unless specified otherwise, all d.c. measurements are made with the chassis as ground reference.

7-1 SETTING OF THE 610B FRONT PANEL CONTROLS

Set the front panel controls as indicated below.

FREQUENCY CONTROL: to CWF1

F1: 10% up from left end.

F2: at 100%.

SWEEP TIME: .01 sec per sweep.

SWEEP TIME VERNIER: CAL.

SWEEP MODE: AUTO.

VAR FREQ: INTENSITY.

VAR FREQ MKR AMP: CCW.

MODULATION: NORMAL.

BIRDIE MKRS AMPLITUDE: CCW.

(6108 PLUG-IN: HI BAND)

Allow 15 minutes warm-up time.

7-2 POWER SUPPLY RECALIBRATION

a) Check for proper voltage at indicated test points using .02% d.c. voltmeter. These test points are at the socket connectors of printed circuit board 610B-5B

Only if these voltages are not within range, see Section 7-9 for Adjustment Procedure.

Pin 1 610B-5B - - - +30V ±10 mv

Pin 5 610B-5B - - - +11.2V ±5mv

Pin 7 610B-5B - - - +5.6V ±5mv

Pin 9 610B-5B - - - -5.6V ±5%

Pin 18 610B-5B- - - -20V ±10 mv

Pin 2 J401 - - - high voltage required by plug-in installed in the instrument ±5%.

NOTE:
In some older instruments the +11.2V Power Supply Voltage is produced by two 5.6 V Zener diodes in series. These diodes are matched in breakdown voltage to within ±20 mv of each other. If these diode voltages are out of tolerance, the diode assembly should be replaced. It is recommended that this be done at the factory.

b) Measure the ac ripple and noise on all supply voltages at the points indicated in part a. Using a Tektronix 503 or other oscilloscope of comparable sensitivity, the ripple and noise on all supplies (except the HIGH VOLTAGE SUPPLY) should be less than 1 mv P-P. The ripple on the HIGH VOLTAGE SUPPLY should be less than 5 mv P-P. If the ripple and/or noise on any of the supply voltages is greater than the above values, see Section 7-17 for trouble shooting procedures.

7-3 SWEEP GENERATOR RECALIBRATION

Set the FREQUENCY CONTROL - F1 to F2
All other controls are as in 7-1.

a) Connect the Vertical Input of a d.c. oscilloscope to Pin 2 of the 610B-3A printed card socket and check for the sweep waveform as shown in Fig. 7A below.

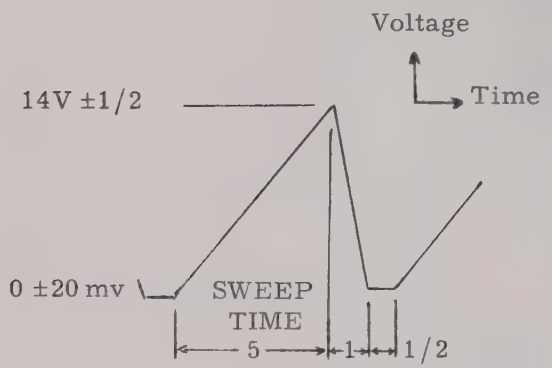


Figure 7A

SWEEP WAVEFORM AT PIN 2 610B-3A

b) With the SWEEP VERNIER on CALIBRATE, check the sweep time on all sweep ranges against the calibrated oscilloscope time base. Sweep times should be within ±20% of dial indication. The relative times for sweep return and hold off, as indicated in Fig. 7A, are ±20% values.

If any of these values are out of tolerance see Section 7-11 and 7-12 for adjustment procedure.

c) Set the SWEEP MODE to LINE and repeat step (b) above. Set the scope trigger source to Line and check the sweep waveform's synchronization with the sweep of the scope. Turn the SWEEP TIME VERNIER through its full range and check for smooth change in sweep time and for at least a 10 to 1 range of control. If adjustments are necessary, see Section 7-11.

d) SET SWEEP MODE to TRIG. and observe that there is no sweep. Press push button on front panel and observe single sweep with each release of button. With a 1V Peak to Peak 10 Hz square wave applied at TRIGGER IN at the rear of the instrument a normal sweep should be observed.

7-4 SWEEP DRIVER RECALIBRATION

Set the FREQUENCY SELECTOR knob in the F1 to F2 position and all other controls as specified in Section 7-1.

a) Connect the output of PIN I of J103 to the Vertical Input of a d.c. oscilloscope (J103 is located on the rear panel of the instrument.) The waveform observed should be the same as the one shown in Fig. 7B.

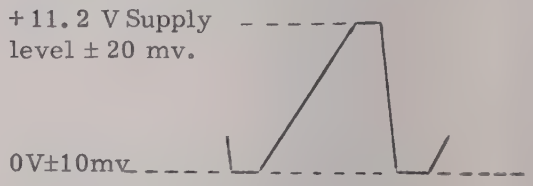


Figure 7B

SWEEP WAVEFORM ON PIN I OF J103

To determine the proper maximum sweep voltage measure the +11.2V supply level on Pin F of J103, using the most sensitive d.c. oscilloscope range possible. This voltage may fall within a 5% tolerance of 11.2V because of the zener diode tolerance. Mark this level on the face of the oscilloscope and without

changing the control settings on the scope, reconnect the Vertical Input to Pin I of J103. The sweep end level of the waveform should be at the same level as the +11.2V mark. If adjustments are necessary, see Section 7-13.

b) MANUAL SWEEP RECALIBRATION

Set SWEEP MODE to MANUAL, FREQUENCY SELECTOR to F1 to F2, and all other controls as specified in Section 7-1. Turn the SWEEP MODE VERNIER CW until the voltage on Pin I of J103 comes up to the +11.2V level described in Section 7-4a. The voltage at the HORIZ OUT on the front panel should be 10 V ±0.2V. If adjustment of the HORIZONTAL OUTPUT voltage is necessary, see Section 7-13c.

7-5 FREQUENCY INSTRUCTION RECALIBRATION

a) Dial assembly mechanical inspection.

1. With the F1, F2 and VAR FREQ MKR controls turned fully to the CCW, all three pointers should be within 1/32" alignment and approximately 1/16" to the left of the scale calibrations.

2. With the above controls turned fully CW, the three pointers should be 1/16" beyond the right end of the scale and have a maximum deviation in position of 1/16".

3. If dial pointers are out of tolerance, see Section 7-14.

b) Set the F1 and F2 pointers exactly on zero. Set the FREQUENCY SELECTOR control to F1 to F2 and set all other controls as in 7-1.

1. View the sweep signal on Pin C J103 (located on the rear panel of the instrument) with an a.c. coupled oscilloscope. The sweep signal should be less than 20 mv peak-to-peak.

2. With the oscilloscope removed, connect a .02% d.c. voltmeter to Pin C of J103. The d.c. voltage present should be 0V ±10 mv.

3. Remove the lower dust cover and, without changing the control settings, connect the .02% d.c. voltmeter to Pin 24 of J401, located on the rear panel of the instrument. The voltage here should be 0 V ±10 mv.

4. Set the F1 and F2 pointers exactly on 100%. Reconnect the d.c. voltmeter to Pin 24 of J401. The voltage on the d.c. voltmeter should be 9.75V ±20 mv.

5. Set the F1 pointer on 0 and the FUNCTION SWITCH to CWF1. The voltage on the d.c. voltmeter should be 0V ±20 mv.

6. Set the VARIABLE FREQ. MARKER to 5% of the dial reading and the FREQ. SELECTOR SWITCH to ΔF. Turn ΔF control to 5 and observe 500 mv Peak to Peak waveform on Pin C J103 with a d.c. oscilloscope.

7. Set the FREQ SELECTOR control to F1 to F2.
Set the F1 pointer exactly on 0.
Set the F2 pointer exactly on 100%.
Connect the vertical input d.c. oscilloscope to Pin 24 of J401.
The waveform seen should be

as shown in Fig. 7C below. This is the sweep waveform that drives the Frequency Control circuits in the plug-in and it will be referred to in the plug-in recalibration procedures.

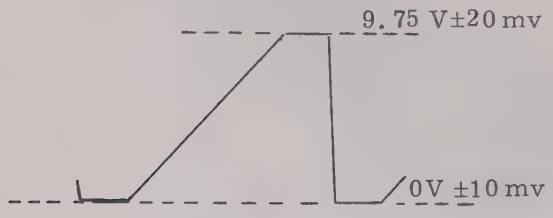


Figure 7C
SWEEP WAVEFORM ON PIN 24 OF J401

8. If any of these voltages are out of tolerance, see Section 7-15 for the adjustment procedure.

7-6 VARIABLE FREQUENCY MARKER RECALIBRATION

Set the FREQ SELECTOR control to F1 to F2 and the VAR FREQ MKR AMP control to VIDEO
All other controls are set as in Section 7-1.
Connect the oscilloscope as shown in Fig. 7D.

a) Set the F1 pointer at 0% of the dial range.
Set the F2 pointer at 10% of the dial range and the
VAR FREQ MKR POINTER on 5% of the dial setting.
Turn VAR FREQ MKR AMP control CW until the video pip is visible. The pip should be in the central ±5% of the sweep.

b) Set the F1 pointer on 90%.
Set the F2 pointer on 100%, and the VARIABLE FREQ pointer on 95%.
Repeat the check made in step a).

c) If the marker is out of tolerance in either step a) or b), see Section 7-10 for adjustment.

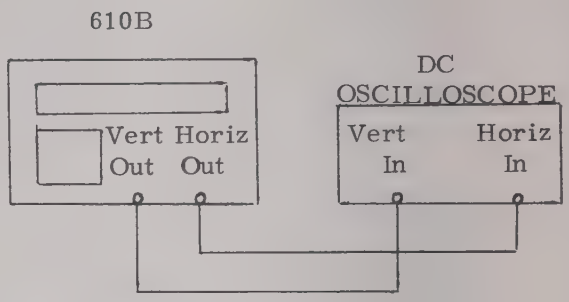


Figure 7D

7-7 LEVEL CONTROL RECALIBRATION

Set front panel controls as in sec. 7-1.

1. With plug-in installed, connect .02% dc voltmeter to pin 10 of J401 (Located on rear panel behind the plug-in). Adjust the RF POWER LEVEL control on the plug-in front panel for -.170V.

2. Connect .02% dc voltmeter to pin 18 of J401. Without changing the plug-in power level control, the voltage on pin 18 should be within ±2mv of the voltage recorded in step 1. above. If this voltage is out of tolerance see sec. 7-16A.

7-8 HARMONIC MARKER RECALIBRATION

Remove the bottom dust cover of the 610B. Unhook the BNC cable from the 61HH or 61H Harmonic marker generator at the Birdie Marker Mixer located on the rear panel of the instrument and connect to HP5246L Electronic Counter. Put both 1 and 10MHz and the 50 and 100 MHz toggle switches to their center positions.

a) Throw the toggle switch on front panel to 10MHz Harmonic and observe the frequency of 10MHz ±1kHz from the Marker Generator.

b) Throw the toggle switch to 1MHz Harmonic and observe the frequency of the 1MHz ±100Hz from the Marker Generator

c) Put 1 and 10MHz toggle switch to its center position and throw the second toggle switch to 50MHz. Observe the frequency of 50MHz ±5kHz from the Marker Generator.

d) Throw the second toggle switch to 100MHz. Observe the frequency of 100MHz ±10kHz from the Marker Generator.

e) If any of the marker generators are out of tolerance, see Sec. 7-16B for adjustment.

ADJUSTMENT PROCEDURES

The adjustments described in this section are to be made only if the voltages and waveforms described in the RECALIBRATION PROCEDURE are out of tolerance. Random adjustment of the internal controls without reference to the recalibration procedure will cause a deterioration of the instrument's overall calibration and accuracy. Most of the internal adjustments are made on controls located on the printed circuit cards mounted on the under side of the main deck. Remove the bottom dust cover for access to these internal adjustments. A card extender is available for access to the adjustable components located on the printed circuit cards.

7-9 POWER SUPPLY ADJUSTMENTS

Set controls as described in Section 7-1.

a) Monitor the +11.2V power supply at Pin 5 of the socket connector of the printed circuit board 610B-5B. The +11.2V supply is adjusted with R537 on the PC 610B-5B. Using a .02% d.c. voltmeter, set the +11.2V supply for 11.200V ±1mv.

Monitor the +5.6V power supply at pin 7 of the socket connector of the printed circuit board 610B-5B. The +5.6V supply is adjusted with R545 on the PC 610B-5B. Using a .02% d.c. voltmeter, set the +5.6V supply for 5.600V ±1mv

Note: Changing the +11.2V supply voltage will require resetting the +30V and -20V supplies. See steps b and c below.

Power Supply Adjustments - Cont'd.

b) Monitor the +30V power supply at Pin 1 of the socket connector of the printed circuit board 610B-5B. The +30V power supply is adjusted with R512 on PC 610B-5B. Using a .02% d.c. voltmeter, set the +30V supply for +30V ±6mv. Changes in the +30V supply may also affect the -20V supply and it should subsequently be checked after adjusting the +30V supply. Monitor the -20V power supply at Pin 18 of printed circuit board 610B-5B.

c) The -20V power supply is adjusted with R524 on PC 610B-5B. The -20V supply should be adjusted only after the +30V supply has been checked. Using a .02% d.c. voltmeter, set the -20V supply for -20V ±4mv.

d) There are no control adjustments for the High Voltage power supply. If this supply is operating improperly, see Sec. 7-17 for Trouble Shooting procedures.

7-10 VARIABLE FREQUENCY MARKER ADJUSTMENTS

Set controls as indicated in Sec. 7-6 and connect the d.c. oscilloscope as shown in Fig. 7C.

a) Set controls as described in Sec. 7-6a. Adjust R322 BALANCE on Pc 610B-2a to place the marker in the center of the sweep ±5%.

b) Set controls as described in Sec. 7-6b. Adjust R317 CALIBRATE on PC 610B-2a to place the marker in the center of the sweep ±5%.

c) Repeat steps a and b until no further adjustment is necessary.

d) Connect the Vertical Input of the d.c. oscilloscope to Pin 5 of the 610B-2a printed card socket. With the VAR FREQ MKR AMP control turned full CW adjust R325 MAX AMP ADJ on PC 610B-2a for a peak of +0.6V. See Fig. 7F.

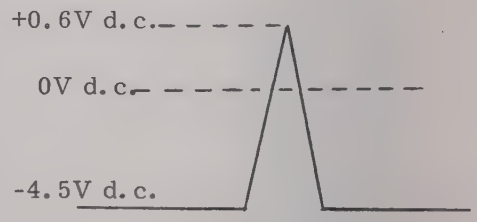


Figure 7F
VIDEO PIP ON PIN 5 OF 610B-2A SOCKET

Variable Frequency Marker Adjustments Cont'd.

e) Connect the Vertical Input of the d. c. oscilloscope to Pin 2 of the 610B-3A printed card socket. With the VAR FREQ MKR AMP control turned fully CW and F1 set on 0% F2 set on 100% full scale, and VAR FREQ MKR set midscale, adjust R341 DWELL ADJUST on PC 610B-2A for a step of 0. 4 cm on a 5 cm sweep. See Figure 7G.

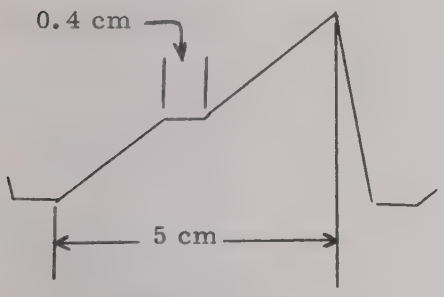


Figure 7G

SWEEP WAVEFORM ON PIN 2 OF 610B-3A

7-11 SWEEP GENERATOR ADJUSTMENTS

Set FREQUENCY SELECTOR to F1 to F2. All other controls set as in 7-1.

Connect the Vertical Input of the d. c. oscilloscope to Pin 2 of the 610B-3A PC socket. and observe the waveform shown in Fig. 7A.

a) Adjust R127 SWEEP START LEVEL on PC 610B-2A for sweep start at 0V ±20 mv.

b) Adjust R131 SWEEP END LEVEL on PC 610B-2A for sweep amplitude of 14V.

c) Turn SWEEP VERNIER (R134) fully CCW and short its wiper to ground. Adjust R126 BIAS ADJUST on PC 610B-3A for slow positive growth of sweep voltage. (NOTE Voltage must not go negative.)

d) Remove short, turn Vernier to CAL and observe sweep. Repeat steps a, b, and c if necessary.

e) Make the following control settings.

FREQUENCY SELECTOR control: F1 to F2.
SWEEP TIME: 1 - .1 sec. per sweep.
SWEEP MODE: LINE SYNC,

Set all other controls as in Sec. 7-1. Connect the Vertical Input of the d. c. oscilloscope to Pin 2 of the 610B-3A PC socket and observe sweep as shown in Fig. 7A. Connect the .02% d. c. voltmeter to Pin 6 of the 610B-3A PC socket.

f) Adjust R138 TRIGGER ADJ, located on the under side of the main deck, until the sweep just stops. Turn the SWEEP MODE control on the front panel to TRIG and record the voltage on Pin 6 of the 610B-3A PC socket.

g) With the SWEEP MODE in the TRIG position, adjust R138 TRIGGER ADJ. until the sweep starts again. This is a free running sweep. Back off on R138 until the sweep just stops and record the voltage on Pin 6 of the 610B-3A PC socket.

h) With the SWEEP MODE still in the TRIG. position, adjust R138 for a voltage on Pin 6 of the 610B-3A PC socket midway between the two voltages recorded in parts a and b ± 50 mv.

i) After adjusting R138 note that there is no sweep in the TRIG position of the SWEEP MODE and a normal sweep in the LINE SYNC position.

If proper sweep cannot be obtained, see Sec. 7-17 for Trouble Shooting Guides.

7-12 EXT TRIG and HOLD OFF ADJUSTMENTS

a) Set FREQUENCY SELECTOR: F1 to F2. Set SWEEP MODE to TRIG. Set all other controls as in Sec. 7-1. Connect the Tektronix 181 Time Base Generator through an attenuating network to the TRIGGER IN jack at the rear of the instrument. See Fig. 7H. Set the Tektronix 181 OUTPUT SELECTOR to 1 ms OUTPUT.

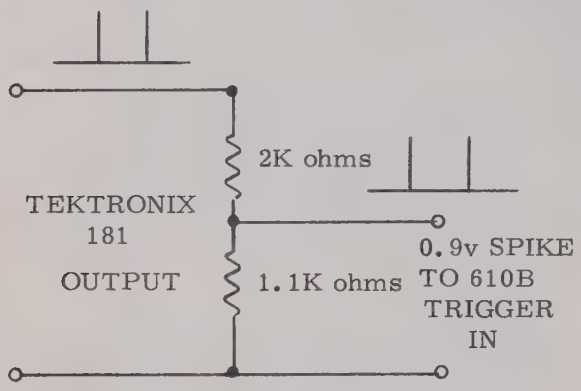


Figure 7H

ATTENUATOR NETWORK FOR EXT. TRIGGER ADJ.

b) With a 0.9v spike applied to the TRIGGER IN, a normal sweep should be observed at Pin 2 of the 610B-3A PC socket. If there is no sweep, adjust R148 EXT TRIG ADJ on the 610B-3A PC until a sweep is obtained. Set the control for the middle of its operating range.

c) With the sweep triggered externally as described in e and f, turn the SWEEP TIME selector through all of its ranges and check each range for the minimum hold-off time described in Sec. 5-3. If any range has a hold-off time less than the minimum, adjust R151 HOLD-OFF ADJ on the 610B-3A PC to bring the hold-off time up to the minimum.

If all of the hold-off times are over the minimum, bring the shortest hold-off time down to the minimum with R151.

If it is impossible to achieve any of these steps, see Sec. 7-17 for the Trouble Shooting procedure.

In some of the early 610B models, provisions for EXT TRIG ADJ and HOLD-OFF ADJ were not incorporated.

7-13 SWEEP DRIVE ADJUSTMENTS

Set the FREQUENCY SELECTOR control in the F1 to F2 position. Set all other controls as described in Section 7-1.

a) View the +11.2 V on Pin F of J103 using an a.c. oscilloscope at max. sensitivity. Adjust R216 -- SWEEP RIPPLE ADJUST on PC 610B-1A for minimum ripple.

b) View the sweep on Pin I of J103 with a d.c. oscilloscope. Adjust the sweep start level with R206 — BEGIN ADJUST located on the main deck for 0 V ±10 mv.

c) Calibrate the vertical gain of the oscilloscope with reference to the +11.2V supply as described in Sec. 7-4b.

1. With the d.c. oscilloscope connected to Pin I of J103, adjust the sweep end level with R201 END ADJUST, located on the main deck, to the same level as the +11.2 V supply ±20 mv.

2. Turn SWEEP MODE to MAN. and turn the vernier until the sweep on the oscilloscope is at the +11.2 V level. Connect the .02% d.c. voltmeter to the HORIZ OUT on the front panel and adjust R209 HORIZ CAL located on the 610B-1A PC for 10 V±50 mv on the voltmeter.

7-14 MECHANICAL ADJUSTMENT OF DIAL POINTERS

a) Turn all three pointer controls CCW until they reach the end of their travel. Adjust the F1 and F2 pointers by loosening the 4-40 set screw in the top of the slide block and aligning the pointers 1/16" beyond the 0 marker of the dial. When tightening the set screw, do not apply torque as this may damage the dial cord.

b) To adjust the VAR FREQ MARKER pointer loosen the set screw in the rear of the slide block which is accessable through the 3/8" hole in the dial frame and bring pointer into alignment with F1 and F2.

c) In some of the early 610B models provisions for adjusting the pointer were not incorporated. To adjust the pointer position in one of these instruments, it is necessary to loosen the two set screws on the potentiometer dial control drum that hold the drum to the potentiometer, and turn the drum to achieve the desired alignment.

7-15 FREQUENCY INSTRUCTION ADJUSTMENT

Caution: Do not perform the following calibration if the frequency instruction accuracy is acceptable.

NOTE: Mechanical Alignment of dial pointers must be correct to have proper results from these adjustments! See Sec. 7-5a for mechanical inspection of dial pointers.

a) Set FREQUENCY SELECTOR — F1 TO F2
Set all other controls as described in Sec. 7-1.

1. Set F1 and F2 pointers exactly on 0. Connect the d.c. oscilloscope to Pin C of J103 on the rear deck of the instrument and observe the sweep waveforms. Adjust R231 TRACKING on the 610B-1A PC for a minimum amplitude of the sweep waveform. Disconnect the oscilloscope.

2. Connect the .02% d.c. voltmeter to Pin C of J 103 in place of the oscilloscope. Adjust R245 FREQ ZERO on the main deck for 0V ±5 mv on the voltmeter.

3. Set F1 and F2 pointers exactly on 0. Connect the .02% d.c. voltmeter to Pin 24 of J 401 located on the rear deck of the instrument. Adjust R354 FREQUENCY CONTROL ZERO (this is the unmarked thumb-pot on the upper side of the main deck located at the rear of the deck) for 0V ±5 mv.

4. Set F1 and F2 pointers exactly on 100%. Adjust R233 AMPLITUDE on the 610B-1A PC for 9.75 ±10mv on the voltmeter.

5. Repeat steps 2 and 3 above until the voltages stay within their tolerances.

b) Set FREQUENCY SELECTOR to CW F1 and the F1 pointer exactly on zero. With the .02% d.c. voltmeter connected to Pin 24 of J401. adjust R243 ΔF OFFSET on PC 610B-1A for 0V ±10 mv.

c) Set FREQUENCY SELECTOR to ΔF.
Set VAR FREQ MARKER to 5% of the dial scale. Turn ΔF control to 5 and observe sweep on Pin C of J103. with the d.c. oscilloscope. Adjust R225 ΔF CAL for a 500 mv ±50 mv P-P sweep waveform.

Frequency Instruction Adjustment Cont'd.

d) Repeat Recalibration Section 7-5b to insure the correct recalibration of the frequency instruction circuits. If the correct voltages and waveforms cannot be obtained, see Section 7-17 for trouble shooting suggestions.

7-16A LEVEL CONTROL ADJUSTMENT.

Set front panel controls as in Sec. 7-1.

1. With plug-in installed, connect .02% dc voltmeter to pin 19 of J401 (Located on the rear panel behind the plug-in). Adjust the RF Power Level control on the plug-in front panel for about -170mv on pin 19. Record the voltage.

2. Connect .02% dc voltmeter to pin 18 of J401 without changing the plug-in power level control, adjust R408 LEVEL BALANCE ADJ on PC 610B-4 to bring the voltage on pin 18 to within 0.2mv of the voltage recorded above in step 1.

7-16B HARMONIC MARKER GENERATOR ADJUSTMENT

Connect counter to output of harmonic marker Generator as described in Sec. 7-8.

See Fig 7-I below for location of adjustments.

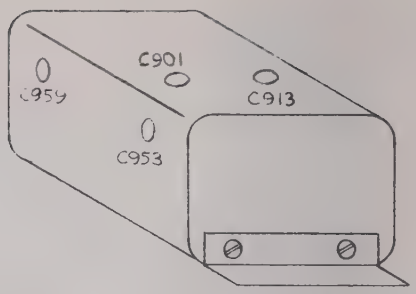


Fig 7I - 61HH adjustment locations

a) To adjust the 10MHz harmonic, adjust C913 to produce a signal 10MHz ±1kHz.

b) To adjust the 1MHz harmonic adjust C901 to produce a signal 1MHz ±100Hz.

c) To adjust the 50MHz harmonic adjust C953 to produce a signal of 50MHz ±5kHz

d) To adjust the 100MHz harmonic adjust C959 to produce a signal of 100MHz ±10kHz.

e) To adjust the 61H 1 and 10 MHz Harmonic Marker it is necessary to remove the front end and the cover of the unit to reach the adjustments.

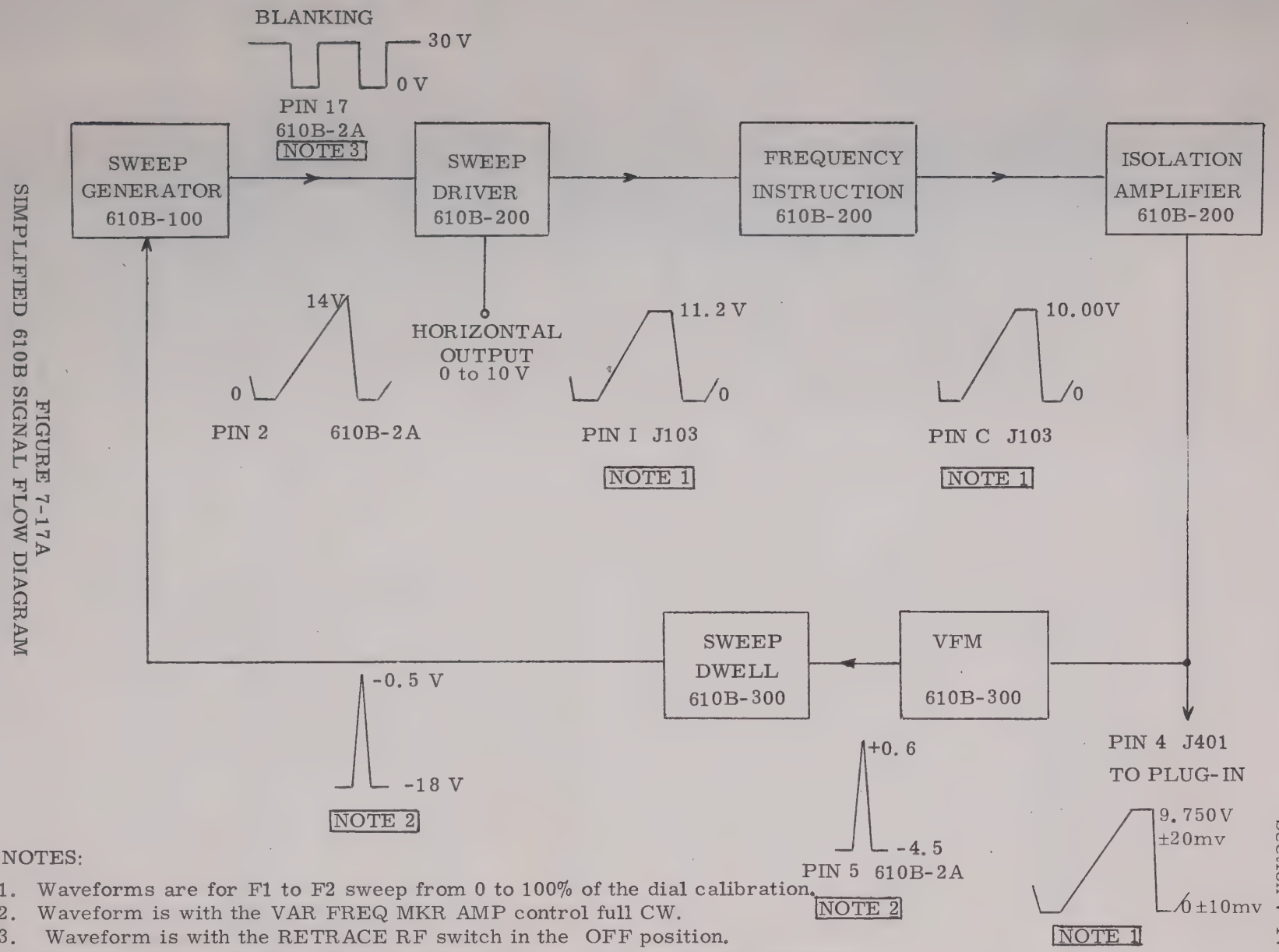


FIGURE 7-17A
SIMPLIFIED 610B SIGNAL FLOW DIAGRAM

NOTES:

1. Waveforms are for F1 to F2 sweep from 0 to 100% of the dial calibration.
2. Waveform is with the VAR FREQ MKR AMP control full CW.
3. Waveform is with the RETRACE RF switch in the OFF position.
4. Numbers inside the boxes designate drawing number for schematic diagrams of the circuits.

610B TROUBLE SHOOTING CHART

GENERAL

INDICATION	POSSIBLE CAUSE AND REMEDY
No RF OUTPUT	a) Check RETRACE RF switch. If it is in the ON position there will be no base line since the RF is on during the retrace. b) See Plug-In Trouble Shotting guide.
No Horizontal Sweep	a) Check control settings, see Section 2. b) Check for sweep at Pin 2 of 610B-3A PC socket. (See Fig. 7A) 1. If good see Sweep Driver Trouble Shooting procedure. 2. If bad see Sweep Generator Trouble Shooting Procedure.
Cannot sweep full frequency range	a) Check front panel control settings. FREQUENCY SELECTOR - F1 to F2 MODULATION - NORMAL b) Check power supply voltages as described in Section 7-2. c) Check waveform at Pin 24 of J401 on rear panel of 610B. (See Section 7-5, step 7, for description of the waveform.) 1. If the waveform is correct, see the plug-in trouble shooting procedure. 2. If the waveform is bad refer to Section 7-2 through 7-5 for Recalibration procedure.
No VARIABLE FREQUENCY MARKER indication	a) Check for proper waveform at Pin 24 J401 on rear panel (see section 7-5, step 7, for description of the waveform.) 1. If the waveform is bad refer to Section 7-2 through 7-5 for Recalibration procedure.

610B TROUBLE SHOOTING CHART

GENERAL Cont'd.

INDICATION	POSSIBLE CAUSE AND REMEDY
No VARIABLE FREQUENCY MARKER indication (continued)	2. If the waveform is good see the Trouble Shooting Chart for the VARIABLE FREQUENCY MARKER.
External RF MARKER does not operate but internal markers are o. k.	a) Turn off harmonic markers. All marker RF signals are fed into a single mixer. The 1 and 10 MHz harmonic markers beat with all other RF marker inputs. b) Use larger amplitude signal (1 V).
NARROW markers are poorly shaped but WIDE markers are o. k.	a) Reduce sweep rate to 0. 1 seconds per sweep or less.
Noise on detected output.	a) Turn BIRDIE MARKER AMPLITUDE control full CCW.
No birdie markers	a) No output from Harmonic Marker Generator. (See Section 7-8 for recalibration procedure.) b) Mixer diode defective. Check diode in mixer assembly located on the 610B rear panel for a front to back resistance ratio of 100 or greater. c) Video amplifier defective. Check Q301 and Q302 on Printed card 610B-2A.
External level function does not work	a) Adjust EXT LEVEL ADJ (screwdriver adjustment on front panel) for levelled condition. b) Leveling circuit out of balance see Sec. 7-16A for adjustment procedure.

610B TROUBLE SHOOTING CHART

GENERAL Cont'd.

INDICATION	POSSIBLE CAUSE AND REMEDY
No level control, unlevelled, or light stays on	a) Turn MODULATION SWITCH to NORMAL b) See plug-in Trouble Shooting guide for level circuit trouble shooting.
Cannot externally frequency program over the whole frequency range	a) Turn FREQ CONTROL on the front panel to REMOTE b) Program circuit impedance is too low. See Section 4.
Cannot make phase lock function work	a) Check the time constants of the external phase lock control system.

POWER SUPPLY

+11.2V supply cannot be adjusted; or excessive noise on +11.2V supply.	a) CR521 is defective b) Q506 is defective c) Check +30 V supply for large AC ripple.
+30V Supply cannot be adjusted. +11.2V supply is o.k.	a) Check Q502, Q503, Q504, and Q506. b) Check CR501, CR502, CR503, and CR504 for open (located on TB-1).
+30V supply high with large AC ripple and cannot be adjusted	a) Q501 or Q502 shorted. b) Check Q503 and Q506.
-20V Supply cannot be adjusted. +30V Supply is o.k.	a) CR519 is defective. b) Check Q508, Q509, Q510, Q511. c) Check CR505, CR506, CR507, and CR508 for open. (Located on TB-1).

610B TROUBLE SHOOTING CHART
POWER SUPPLY Cont'd.

INDICATION	POSSIBLE CAUSE AND REMEDY
High voltage supply at +160V	a) Check to see that plug-in is properly installed. b) Q410 shorted c) Check Q411 and Q412
High voltage supply low or inoperative	a) Check +30V supply for proper operation b) Check Q411 and Q412
Excessive ripple on all supplies	a) Make sure you are using a low frequency oscilloscope. b) Check 11.2V supply for proper operation (See Section 7-2). c) Set FREQUENCY SELECTOR to CWF1.
Noise on +30V supply, +11.2V supply o.k.	a) Set FREQUENCY SELECTOR to CWF1. b) Q503 or Q504 is noisy. c) Q506 is noisy or intermittent.
Noise on -20V supply, +11.2V and +30V supplies o.k.	a) Q509 or Q510 is noisy. b) Q511 is noisy or intermittent c) CR519 is defective.
Noise on +5.6V supply or cannot ADJ +5.6V supply (11.2V supply o.k.)	a) Q513 or Q514 or Q515 is defective.

610B TROUBLE SHOOTING CHART

SWEEP GENERATOR

INDICATION	POSSIBLE CAUSE AND REMEDY
No sweep	a) Check setting of SWEEP MODE and FREQUENCY SELECTOR controls on front panel. b) Turn CCW the amplitude control of the VAR FREQ. MKR. c) Check Pin 2 of printed circuit board 610B-3A. If there is no sweep check SWEEP BIAS ADJUST setting (See Section 7-11). d) *Check Q104 and Q107
Sweep too slow. Vernier has little or no effect on sweep speed	a) Check Q310 in PC 610B-2A. b) If the frequency determining plug-in is not installed, this will cause the problem.
Sweep time too slow/fast on all ranges	a) Check SWEEP BIAS ADJ setting. (See Section 7-11.) b) *Replace Q104.
No sweep or jumpy sweep on line sync, auto o. k.	a) Reset sweep trigger level. (See Section 7-12.)
No BLANKING OUT - Sweep o. k.	a) Check Q108.
No Base Line on Detected Output	a) Turn RETRACE RF to OFF. b) Check to see that you are getting RF output from plug-in. c) Check Q109.
Sweep stops part way through its cycle	a) Turn VARIABLE FREQ. MKR. AMPLITUDE to CCW. (If this frees the sweep, See Section 7-10 for marker amplitude adjustment.)

*Changing Q104 may require a change in R116 to achieve proper sweep times. See Section 7-4 for Recalibration procedure.

610B TROUBLE SHOOTING CHART

SWEEP DRIVE

INDICATION	POSSIBLE CAUSE AND REMEDY
END ADJUST cannot bring sweep drive output up to +11.2V supply level	a) Check output of Sweep Generator on Pin 2 610B-3A for proper sweep waveform and amplitude. (See Figure 7A.) b) Check power supply voltages. (See Section 7-2.)

FREQUENCY INSTRUCTION

Cannot adjust FREQUENCY ZERO for 0V on Pin C of J103	a) Check setting of front panel controls and frequency control pointers. (See Section 7-5.) b) Check Q203 differential amplifier on PC 610B-1A for unbalanced inputs using .02% d.c. voltmeter.
No sweep waveform on Pin 24 J401 but Sweep WF is o.k. on Pin C J103	a) Check for Jumper between Pins B and C on J103. b) Check ISOLATION AMPLIFIER for proper operation. c) Check input circuit of plug-in for short circuit.

610B TROUBLE SHOOTING CHART

VARIABLE FREQUENCY MARKER

INDICATION	POSSIBLE CAUSE AND REMEDY
Cannot recalibrate Variable Frequency marker	a) Check Q306 and Q307 for balanced operation. b) CR305 or CR306 defective. c) Q305 defective.
No intensity but Video marker o. k.	a) Q310 defective. b) Dwell adjust out of tolerance. (See Section 7-10.)
No RF marker but Video and intensity markers o. k.	a) Check MAX AMP ADJ setting, See Section 7-10.

REQUIRED TEST EQUIPMENT

INSTRUMENT	REQUIRED CHARACTERISTICS	RECOMMENDED INSTRUMENT
DC Voltmeter	a) .02% Accuracy b) Input impedance greater than 5 megaohms c) Resolution of 1mv or greater d) Center scale zero	JOHN FLUKE Model 871
DC Oscilloscope	a) 300 KC Bandwidth and horizontal amplifiers, internal sweep b) Vertical sensitivity of 1 mv/cm for AC and DC inputs c) Horizontal input for external sweep signal	TEKTRONIX Model 503
V O M (Volt-ohm-meter	a) 20,000 ohm/V DC	SIMPSON Model 270
PULSE GENERATOR	a) 1 kHz pulse rate with 10ms or less period	TEKTRONIX 181 TIME MARK GENERATOR
CRYSTAL DETECTOR	a) Flat Response (±1 db 100 kHz to 4 GHz) b) Good RF bypassing 100 kHz to 4 GHz	WILTRON Model 61DN
PLUG-IN EXTENDER CABLE	a) 3 FT. LENGTH b) Shielded cables for small signals	WILTRON Model 610B-TI
ELECTRONIC COUNTER	a) 50 ohm input. b) 100kHz to 2GHz range	HP5246L

REQUIRED TEST EQUIPMENT Cont'd.

INSTRUMENT	REQUIRED CHARACTERISTICS	RECOMMENDED INSTRUMENT
RF POWER METER	a) CALIBRATED in dbm b) ±.5 dbm accuracy or better c) 50 ohms input impedance d) Maximum power reading 0 dbm or greater e) Frequency range from 10 MHz to 400 MHz	-hp- 431C POWER METER
RF SIGNAL GENERATOR	a) Frequency range of 10 MHz to 400 MHz b) Calibrated power output in dbm. c) Signal attenuation of 40 db or greater	MEASUREMENTS Model 80

Resistors

R101	10K	1/4W	10%	Fixed	Comp
R102	1.2K	1/4W	5%	Fixed	Comp
R103	10K	1/4W	5%	Fixed	Comp
R104	9.1K	1/4W	5%	Fixed	Comp
R105	6.8K	1/4W	5%	Fixed	Comp
R106	910	1/4W	5%	Fixed	Comp
R107	10K	1/4W	10%	Fixed	Comp
R108	27K	1/4W	10%	Fixed	Comp
R109	10K	1/4W	5%	Fixed	Comp
R110	100K	1/4W	5%	Fixed	Comp
R111	56K	1/4W	10%	Fixed	Comp
R112	13K	1/4W	5%	Fixed	Comp
R113	43K	1/4W	5%	Fixed	Comp
R114	5.6K	1/4W	5%	Fixed	Comp
R115	27K	1/4W	5%	Fixed	Comp
R116	360K	1/4W	5%	Fixed	Comp
R117	36K	1/4W	5%	Fixed	Comp
R118	2K	1/4W	5%	Fixed	Comp
R119	36K	1/4W	5%	Fixed	Comp
R120	5.6K	1/4W	5%	Fixed	Comp
R121	1.5K	1/2W	10%	Fixed	Comp
R122	3.3K	1/4W	10%	Fixed	Comp
R123	10K	1/4W	10%	Fixed	Comp
R124	470K	1/4W	10%	Fixed	Comp
R125	4.7K	1/4W	5%	Fixed	Comp
R126	10K			Var	Comp
R127	5K			Var	Comp
R128	4.7K	1/4W	10%	Fixed	Comp
R129	47K	1/4W	10%	Fixed	Comp
R130	7/5K	1/4W	5%	Fixed	Comp
R131	5K			Var	Comp
R132	4.7K	1/4W	10%	Fixed	Comp
R133	7.5	1/4W	5%	Fixed	Comp
R134	100K			Var	WW
R135	6.8K	1/4W	10%	Fixed	Comp
R136	8.2M	1/4W	5%	Fixed	Comp
R137	150K	1/4W	5%	Fixed	Comp
R138	10K			Var	WW
R139	10K	1/2W	10%	Fixed	Comp
R140	18K	1/2W	10%	Fixed	Comp
R141	4.7K	1W	10%	Fixed	Comp
R142	36K	1/4W	5%	Fixed	Comp
R143	39K	1/4W	10%	Fixed	Comp

Resistors

R144	50K			Var	WW
R145	27K	1/4W	5%	Fixed	Comp
R146	180	1W	10%	Fixed	Comp
R147	56K	1/4W	5%	Fixed	Comp
R148	10K			Var	Comp
R149	27K	1/4W	10%	Fixed	Comp
R150	10K	1/4W	10%	Fixed	Comp
R151	10K			Var	Comp
R152	10K	1/4W	10%	Fixed	Comp
R201	50K			Var	WW
R202	220	1/4W	10%	Fixed	Comp
R203	10K	1/4W	10%	Fixed	Comp
R204	820	1/4W	5%	Fixed	Comp
R205	22K	1/4W	10%	Fixed	Comp
R206	100K			Var	WW
R207	15K	1/4W	10%	Fixed	Comp
R208	8.2K	1/4W	10%	Fixed	Comp
R209	10K			Var	Comp
R210	100K	1/4W	10%	Fixed	Comp
R211	2.4K	1/2W	5%	Fixed	Comp
R212	91K	1/4W	5%	Fixed	Comp
R213	10K	1/4W	5%	Fixed	Comp
R214	150	1/4W	10%	Fixed	Comp
R215	1.8K	1/4W	5%	Fixed	Comp
R216	100			Var	Comp
R217	470K	1/4W	10%	Fixed	Comp
R218	3.3K	1/4W	5%	Fixed	Comp
R219	1.1K	1/4W	1%	Fixed	Film
R220	2K	1/4W	1%	Fixed	Film
R221	2K	Wiltron no.		Var	WW
R222	2K	Wiltron no.		Var	WW
R223	2K	Wiltron no.		Var	WW
R224	39K	1/4W	10%	Fixed	Comp
R225	50K			Var	WW
R226	5K			Var	WW
R227	124K	1/2W	1%	Fixed	Film
R228	82.5K	1/2W	1%	Fixed	Film
R229	187K	1/4W	1%	Fixed	Film
R230	82.5K	1/2W	1%	Fixed	Film
R231	10K			Var	WW

Resistors

R232	105K	1/2W	1%	Fixed	Film
R233	5K			Var	Film
R234	27.4K	1/2W	1%	Fixed	Film
R235	82.5K	1/2W	1%	Fixed	Film
R236	187K	1/4W	1%	Fixed	Film
R237	113K	1/2W	1%	Fixed	Film
R238	37.4K	1/2W	1%	Fixed	Film
R239	8.25K	1/2W	1%	Fixed	Film
R240	37.4K	1/2W	1%	Fixed	Film
R241	37.4K	1/2W	1%	Fixed	Film
R242	27.4K	1/2W	1%	Fixed	Film
R243	10K			Var	WW
R244	1M	1/2W	1%	Fixed	Film
R245	1M			Var	WW
R246	47	1/2W	10%	Fixed	Comp
R247	1K	1/4W	5%	Fixed	Comp
R248	390K	1/4W	5%	Fixed	Comp
R249	5K			Var	Comp
R250	7.5K	1/4W	5%	Fixed	Comp
R251	2.4K	1/4W	5%	Fixed	Comp
R252	100	1/4	5%	Fixed	Comp
R301	100K	1/4W	10%	Fixed	Comp
R302	15K	1/4W	10%	Fixed	Comp
R303	2.2K	1/4W	10%	Fixed	Comp
R304	100K	1/4W	5%	Fixed	Comp
R305	20K	1/4W	5%	Fixed	Comp
R306	6.8K	1/4W	10%	Fixed	Comp
R307	1K	1/4W	10%	Fixed	Comp
R308					
R309	100	1/4W	10%	Fixed	Comp
R310	2K	1/4W	5%	Fixed	Comp
R311	100K			Var	WW
R312	47K	1/4W	10%	Fixed	Comp
R313	49.9	1/2W	1%	Fixed	Film
R314	180K	1/4W	10%	Fixed	Comp
R315	47K	1/4W	10%	Fixed	Comp
R316	82.5K	1/2W	1%	Fixed	Film
R317	10K			Var	WW
R318	174K	1/2W	1%	Fixed	Film
R320	300K	1/4W	5%	Fixed	Comp

Resistors

R321	300K	1/4W	5%	Fixed	Comp
R322	10K			Var	WW
R322A	10K	1/4W	10%	Fixed	Comp
R323	200K	1/4W	5%	Fixed	Comp
R324	62K	1/4W	5%	Fixed	Comp
R325	12K	1/4W	10%	Fixed	Comp
R326	10K			Var	Comp
R327	100K			Var	WW
R328	20K	1/4W	5%	Fixed	Comp
R329	20K	1/4W	5%	Fixed	Comp
R330	390K	1/4W	10%	Fixed	Comp
R331	10K	1/4W	10%	Fixed	Comp
R332	~~100K~~ 47K	1/4W	5%	Fixed	Comp
R333	39K	1/4W	5%	Fixed	Comp
R334	12K	1/4W	5%	Fixed	Comp
R335	68K	1/4W	5%	Fixed	Comp
R336	2.2K	1/4W	5%	Fixed	Comp
R337	10K	1/4W	5%	Fixed	Comp
R338	20K	1/4W	5%	Fixed	Comp
R339	470K	1/4W	10%	Fixed	Comp
R340	24K	1/4W	5%	Fixed	Comp
R341	10K			Var	Comp
R342	20K	1/4W	5%	Fixed	Comp
R343	82K	1/4W	5%	Fixed	Comp
R344	4.7K	1/4W	5%	Fixed	Comp
R345					
R346					
R347	10K	1/4W	10%	Fixed	Comp
R348					
R349	82K	1/4W	5%	Fixed	Comp
R350	100K	1/4W	5%	Fixed	Comp
R351	47K	1/4W	5%	Fixed	Comp
R352					
R353					
R354	15K	1/4W	10%	Fixed	Comp
R401	10K	1/4W	10%	Fixed	Comp
R402	50K			Var	WW
R403	1.5K	1/4W	10%	Fixed	Comp
R404	1K	1/4W	10%	Fixed	Comp
R405	10K	1/4W	10%	Fixed	Comp
R406	100K	1/4W	10%	Fixed	Comp
R407	150K	1/4W	5%	Fixed	Comp

Resistors

R408	1K			Var	Comp
R409	270K	1/4W	5%	Fixed	Comp
R410	15K	1/4W	10%	Fixed	Comp
R411	1K	1/4W	10%	Fixed	Comp
R412	33K	1/4W	5%	Fixed	Comp
R413	330	1/4W	5%	Fixed	Comp
R414	68K	1/4W	10%	Fixed	Comp
R415	36K	1/4W	5%	Fixed	Comp
R416	5.1K	1/4W	5%	Fixed	Comp
R417	15K	1/4W	10%	Fixed	Comp
R418	10K	1/4W	10%	Fixed	Comp
R419	1K	1/4W	10%	Fixed	Comp
R420	120K	1/4W	5%	Fixed	Comp
R421	100K	1/4W	5%	Fixed	Comp
R422	270K	1/4W	5%	Fixed	Comp
R423	2.2K	1/4W	5%	Fixed	Comp
R424	9.1K	1/4W	5%	Fixed	Comp
R425	56K	1/4W	5%	Fixed	Comp
R426	9.1K	1/4W	5%	Fixed	Comp
R427	1M			Var	WW
R428	10K	1/4W	5%	Fixed	Comp
R429	2K	1/4W	5%	Fixed	Comp
R430	160K	1/4W	5%	Fixed	Comp
R431	9.1K	1/4W	5%	Fixed	Comp
R432	130K	1/4W	5%	Fixed	Comp
R433	15K	1/4W	5%	Fixed	Comp
R434	5.1K	1/4W	5%	Fixed	Comp
R435	15	1/4W	10%	Fixed	Comp
R436	47K	1/4W	10%	Fixed	Comp
R437	47K	1/4W	10%	Fixed	Comp
R438	47	1/4W	10%	Fixed	Comp
R439	1.5K	1/4W	5%	Fixed	Comp
R440	120K	1/4W	10%	Fixed	Comp
R441	200K	1/4W	5%	Fixed	Comp
R442	15K	1/4W	10%	Fixed	Comp
R443	110K	1/4W	5%	Fixed	Comp
R444	30K	1/4W	5%	Fixed	Comp
R445	62K	1/4W	5%	Fixed	Comp
R446	39K	1/4W	5%	Fixed	Comp
R447	6.8K	1/4W	5%	Fixed	Comp
R448	68K	1/4W	5%	Fixed	Comp

Resistors

R449	68K	1/4W	5%	Fixed	Comp
R450	330K	1/4W	5%	Fixed	Comp
R451	120K	1/2W	10%	Fixed	Comp
R453	6.2K	1/4W	5%	Fixed	Comp
R452	22K	1/4W	5%	Fixed	Comp
R454	1K	1/2W	1%	Fixed	Comp
R455	91K	1/4W	5%	Fixed	Comp
R456	680	1/4W	5%	Fixed	Comp
R457	47K	1/4W	5%	Fixed	Comp
R458	1K	1/4W	5%	Fixed	Comp
R501	47K	1/4W	10%	Fixed	Comp
R502	1 ohm	3W	5%	Fixed	WW
R503	1 ohm	3W	5%	Fixed	WW
R504	1K	1/4W	5%	Fixed	Comp
R505	3K	1/2W	5%	Fixed	Comp
R506	27K	1/4W	5%	Fixed	Comp
R507	27K	1/4W	5%	Fixed	Comp
R508	15K	1/4W	5%	Fixed	Comp
R509	3.9K	1/4W	5%	Fixed	Comp
R510	3.74K	1/8W	1%	Fixed	Film
R511	27.4K	1/4W	1%	Fixed	Film
R512	50K			Var	Comp
R513	2.21K	1/8W	1%	Fixed	Film
R514	36	1/4W	5%	Fixed	Comp
R515	11K	1/4W	5%	Fixed	Comp
R516	1.5K	1/4W	5%	Fixed	Comp
R517	1 ohm	3W	5%	Fixed	WW
R518	1 ohm	3W	5%	Fixed	WW
R519	1.5K	1/4W	5%	Fixed	Comp
R520	8.2K	1/4W	5%	Fixed	Comp
R521	30K	1/4W	5%	Fixed	Comp
R522	56K	1/4W	5%	Fixed	Comp
R523	15K	1/4W	5%	Fixed	Comp
R524	50K			Var	Comp
R525	9.09K	1/8W	1%	Fixed	Film
R526	22.1K	1/4W	1%	Fixed	Film
R527	3.4K	1/8W	1%	Fixed	Film
R528	1K	1/4W	5%	Fixed	Comp
R529	100	1/4W	5%	Fixed	Comp
R530	13K	1/4W	5%	Fixed	Comp
R531	2K	1/4W	5%	Fixed	Comp
R532	1.5K	1/4W	5%	Fixed	Comp
R533	10K	1/2W	10%	Fixed	Comp

Resistors

R534	10K	1/2W	10%	Fixed	Comp
R535	3K	1/4W	5%	Fixed	Comp
R536	50K			Var	Comp
R537	4.42K	1/4W	1%	Fixed	Film
R538	510	1/4W	5%	Fixed	Comp
R539	1K	1/4W	1%	Fixed	WW
R540	1.24K	1/4W	1%	Fixed	WW
R541	1.5K	1/4W	5%	Fixed	Comp
R542	2K	1/4W	5%	Fixed	Comp
R543	400	3W	5%	WW	
R544	5.62K	1/8W	1%	Fixed	Film
R545	500			Var	Comp
R546	5.62K	1/8W	1%	Fixed	Film
R547	1.5K	1/4W	5%	Fixed	Comp
R548	2.4K	1/4W	5%	Fixed	Comp
R549	510	1/4W	5%	Fixed	Comp
R550	2.7K	1/4W	5%	Fixed	Comp
R551	~~28.7K~~ 11.0K	1/4W	1%	Fixed	Film
R552	~~5.62K~~ 2.0K	1/4W	1%	Fixed	Film
R553	~~27.4K~~ 7.09	1/4W	1%	Fixed	Film
R554	1.2K	1/4W	5%	Fixed	Comp
R555	1K	1/2W	5%	Fixed	Comp

Capacitors

C101	.1μf	200V	20%	Fixed	Mylar
C102	10pf	500V	5%	Fixed	Mica
C103	.001μf	1KV	10%	Fixed	Ceram
C104	.001μf	1KV	10%	Fixed	Ceram
C105	68pf	500V	5%	Fixed	Mica
C106	.001μf	1KV	10%	Fixed	Ceram
C107	2μf	200V	10%	Fixed	Mylar
C108	.2μf	200V	10%	Fixed	Mylar
C109	.02μf	200V	5%	Fixed	Mylar
C110	.002μf	125V	5%	Fixed	Poly
C111	50μf	25V		Fixed	Elect
C112	5μf	50V		Fixed	Elect
C113	.47μf	250V	20%	Fixed	Mylar
C114	.047μf	250V	10%	Fixed	Mylar
C115	.02	500V	20%	Fixed	Ceram

Capacitors

C116	7pf	500V	5%	Fixed	Mica
C117	9pf	500V	5%	Fixed	Mica
C118	51pf	500V	5%	Fixed	Mica
C119	7pf	500V	5%	Fixed	Mica
C201	.001μf	1KV	10%	Fixed	Ceram
C202	.02μf	500V	20%	Fixed	Ceram
C301	.01μf	500V	20%	Fixed	Ceram
C302	~~.01μf~~ .001μf	~~500V~~ 2000V	~~20%~~ 10%	Fixed	Ceram
C303	.05μf	100V+80-	20%	Fixed	Ceram
C304	2000pf	250V	5%	Fixed	Poly
C305	32μf	64V		Fixed	Elect
C306	.01μf	500V	20%	Fixed	Ceram
C307	32μf	64V		Fixed	Elect
C308	.01μf	500V	20%	Fixed	Ceram
C309	32pf	64V		Fixed	Elect
C310	470pf	feed thru		Fixed	Ceram
C311	270pf	500V	5%	Fixed	Mica
C312	47pf	500V	5%	Fixed	Mica
C313	270pf	500V	5%	Fixed	Mica
C314	.01μf	500V	20%	Fixed	Ceram
C401	6.8μf	35V		Fixed	Elect
C402	6.8μf	35V		Fixed	Elect
C403	1μf	200V	20%	Fixed	Mylar
C404	.1μf	250V	20%	Fixed	Mylar
C405	47pf	500V	5%	Fixed	Mica
C406	.001μf	1KV	10%	Fixed	Ceram
C407	.0047μf	500V	20%	Fixed	Ceram
C408	.001μf	1KV	10%	Fixed	Ceram
C409	.033μf	100V	10%	Fixed	Mylar
C410	.033μf	100V	10%	Fixed	Mylar
C411A	80μf	150V		Fixed	Elect
C411B	40μf	150V		Fixed	Elect
C412	.1μf	250V	20%	Fixed	Mylar
C413	.001μf	1KV	10%	Fixed	Ceram
C414	220pf	500V	5%	Fixed	Mica

C415 4.7μf 10V 20% Final Test

Capacitors

.01μf	500V	20%	Fixed	Ceram
.01μf	500V	20%	Fixed	Ceram
1000μf	50V		Fixed	Elect
6.8μf	35V	10%	Fixed	Tant
1000μf	50V		Fixed	Elect
.1μf	200V	10%	Fixed	Mylar
6.8μf	35V	10%	Fixed	Tant
.1μf	200V	10%	Fixed	Mylar
.1μf	200V	10%	Fixed	Mylar
.1μf	200V	10%	Fixed	Mylar
.01μf	500V	20%	Fixed	Ceram
10μf	64V		Fixed	Elect
.047μf	200V	10%	Fixed	Mylar
200pf	500V	5%	Fixed	Mica
32μf	64V		Fixed	Elect
10μf	64V		Fixed	Elect
10μf	64V		Fixed	Elect
32μf	64V		Fixed	Elect
.1μf	200V	10%	Fixed	Mylar

Transformer

Power	Wiltron No. 320-17A

Inductors

50mh	1.17mh	Fixed

Transistors

Q101A	2N3566
Q101B	2N3566
Q102	2N3565
Q103	2N3565
Q104	2N~~4302~~4303
Q105	2N3565
Q106	2N3694
Q107	2N3565
Q108	2N3566
Q109	2N3566
Q110	2N3566
Q111	2N3568
Q112	2N3568
Q201	2N3566
Q202	2N3566
Q203	2N4045
Q204	2N3565
Q205	2N3565
Q206	2N4249
Q207	2N4249
Q208	2N3566
Q301	2N3565
Q302	2N3565
Q303	2N3565
Q304	2N3565
Q305	2N4045
Q306	2N4249
Q307	2N4249
Q308	2N3694
Q309	2N3565
Q310	2N4249
Q406	2N3565
Q407	2N3565
Q408	2N398B
Q409	2N398B
Q410	40422
Q413	2N4249
Q414	2N4249
Q401	2N4249
Q402	2N4249
Q403	2N3565
Q404	2N3694
Q405	2N4390
Q411	SE7001
Q412	SE7001

Transistors

Q501	2N3055	Q511	TD100
Q502	2N4355	Q512	2N2218
Q503	2N3569	Q513	2N4249
Q504	2N3569	Q514	2N3565
Q505	TD100	Q515	2N3565
Q506	μa709	Q516	2N4249
Q507	2N3055		
Q508	2N4355		
Q509	2N3569		
Q510	2N3569		

Diodes

CR101	1N458A	CR406	1N4383
CR102	1N458A	CR407	1N4446
CR103	1N458A	CR408	1N4446
CR104	1N4446	CR409	1N4446
CR105	FD300		
CR106	1N4446	CR501	1N4383
CR107	1N4446	CR502	1N4383
CR108	1N4446	CR503	1N4383
		CR504	1N4383
		CR505	1N4383
CR201	1N4838		
CR202	1N4838	CR506	1N4383
CR203	1N4838	CR507	1N4383
CR204	1N4446	CR508	1N4383
CR205	1N4446	CR509	1N4446
CR206	1N4446	CR510	1N4446
CR301			
CR302	1N82A	CR511	1N4446
CR303	1N4446	CR512	1N4749
CR304	1N4446	CR513	1N4446
CR305	1N4446	CR514	1N4446
CR306	1N4446	CR515	1N4446
CR307	1N4446		
CR308	MA4815A	CR516	1N4446
		CR517	1N4446
		CR518	1N4446
CR401	1N4446	CR519	1N823
CR402	1N4446	CR520	1N4446
CR403	1N4446		
CR404	1N4446	CR521	1N823
CR405	1N4383	CR523	1N4446

Switches

S101	Rotary	Wiltron No. 410-33
S102	Rotary	Wiltron No. 410-22
S103	Pushbutton	Wiltron No. 430-11
S104	Rotary	Wiltron No. 410-9
S201	Rotary	Wiltron No. 410-34
S301	Rotary	Wiltron No. 410-22
S302	Rotary	Wiltron No. 410-22
S401	Rotary	Oak No. 399430-K
S501	Pushbutton	Wiltron No. 430-10
S502	DPDT Slide	Wiltron No. 430-9
S11	SPST	Wiltron No. 420-5
S12	SPST	Wiltron No. 420-5
S13	SPST	Wiltron No. 420-5
S14	SPST	Wiltron No. 420-5
S15	SPST	Wiltron No. 420-5
S16	SPDT	Wiltron No. 420-6

Miscellaneous

Printed Card Socket Cinch 250-18-BO-170
610B-1A thru 610B-6A

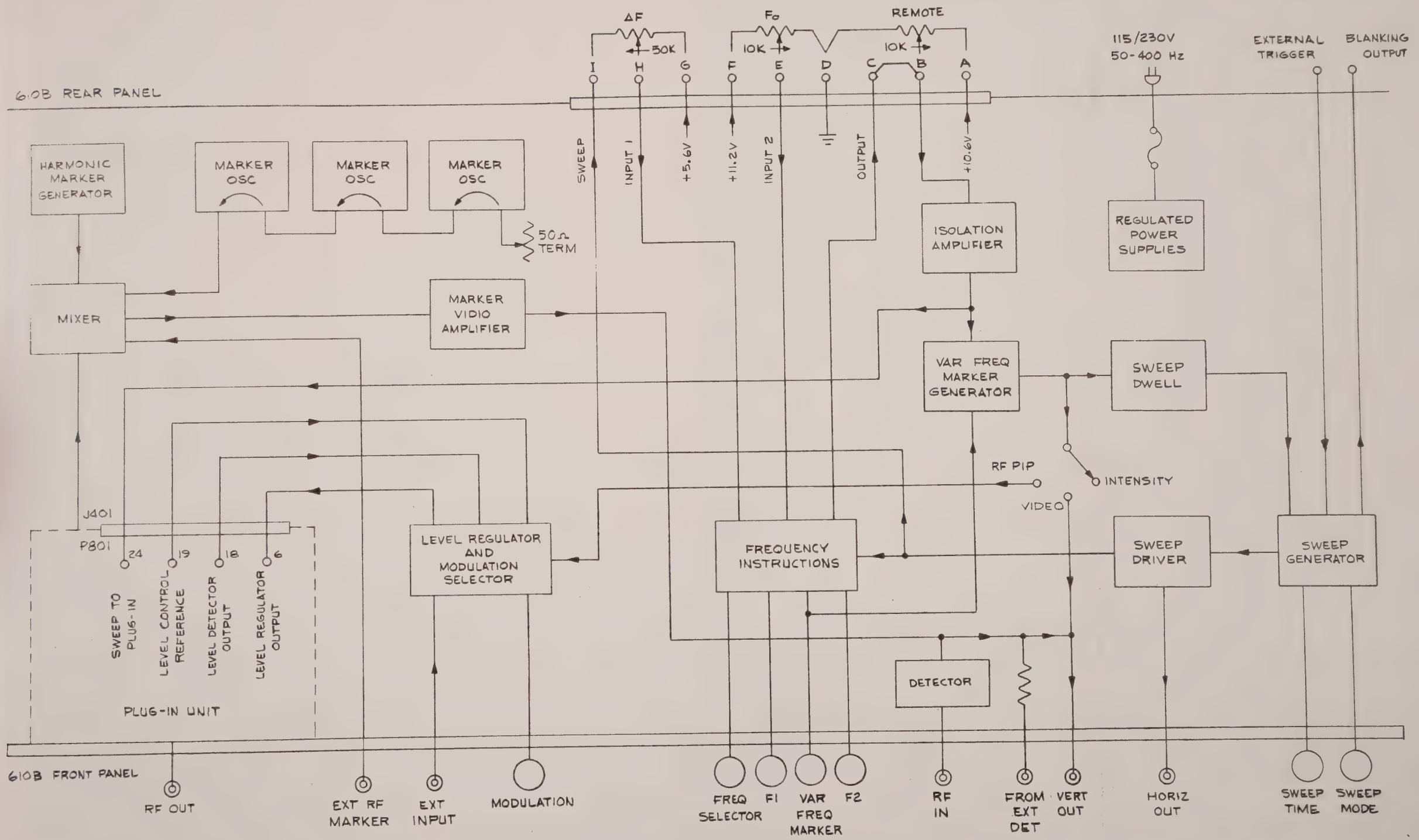
DS401		Wiltron No. 600-74
DS501		Type NE2J
F501	.8A SB	
P501	Power Cord	

3 Pointer Mechanical Dial System
INTERNAL DETECTOR WILTRON Model 61D
BIRDIE MARKER MIXER ASSEMBLY Wiltron No. 610B-MS-40

Connectors

J101	UG-1094/U	J108	UG-1094/U
J102	UG-1094/U		
J103	Cinch 9-140-Y	J401	Amphenol 26-190-24
J104	UG-1094/U		

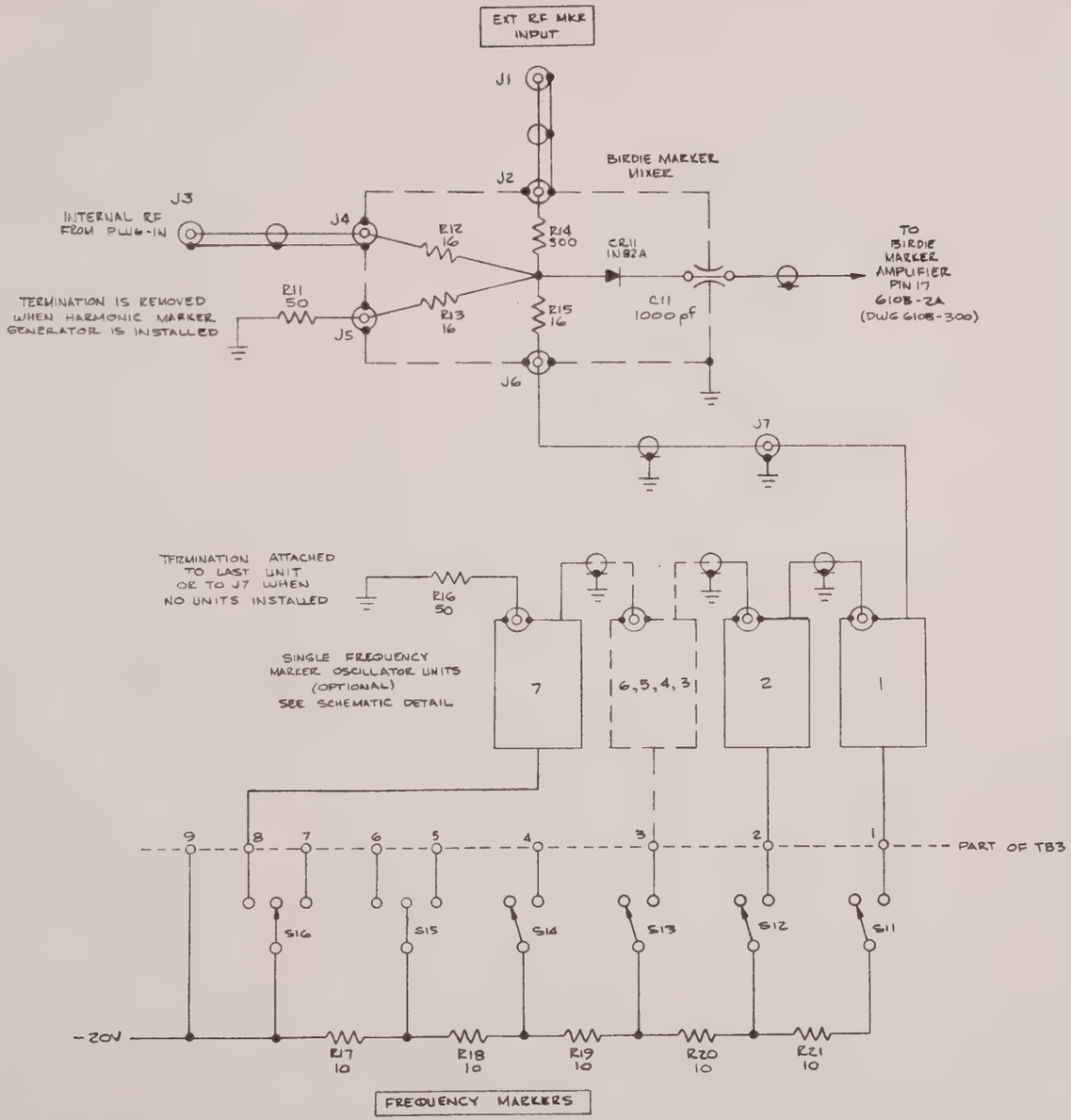
REMOTE OR SWEPT FREQUENCY PROGRAMMING

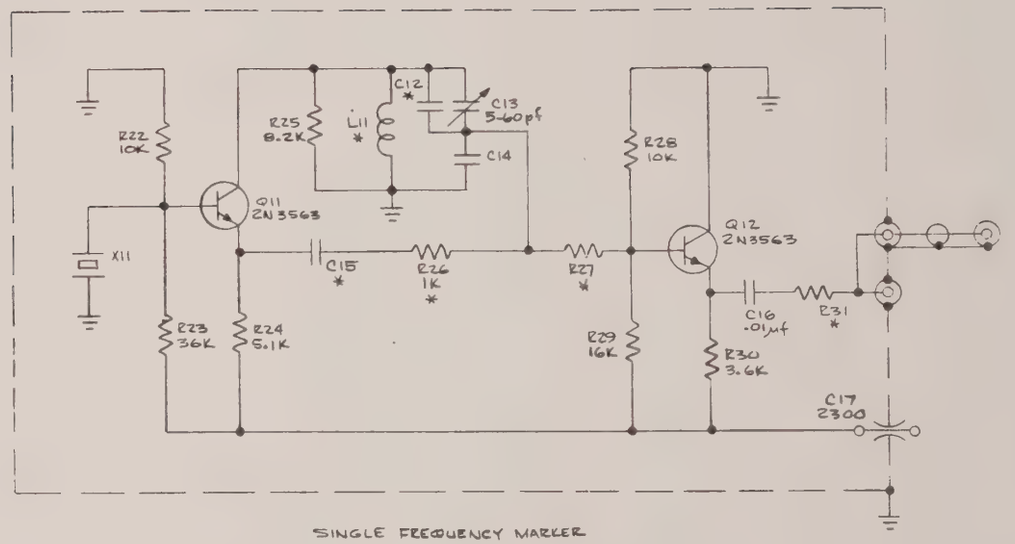


610B FLOW DIAGRAM

610B FLOW DIAGRAM

PRINT: 1-69





SINGLE FREQUENCY MARKER

UNLESS OTHERWISE NOTED:
RESISTANCE IN OHMS
CAPACITANCE IN
INDUCTANCE IN

BIRDIE MARKERS

SWEEP GENERATOR

610B-3A

BLANKING J102 — +30V PULSE DURING RETRACE

1KC BLANKING INPUT FROM PIN 12, 610B-4A (DWG 610B-400)

+30V

BLANKING + → TO R447 (DWG 610B-400); R335 68K; TO PIN 10 610B-2A (DWG 610B-300); J401 PIN 3

BLANKING − → TO PIN 17, 610B-4A LEVEL REGULATOR (DWG 610B-400) AND TO R327 VAR FREQ MKR AMP (DWG 610B-300); J401 PIN 15

RETRACE RF — S104 OFF / ON

R146 180

R141 4.7K; R117 36K; C117 9PF; R120 5.6K; CR107 IN4446; R121 1.5K; Q111 2N3638; C118 51PF; R145 27K; C119 7PF; Q112 2N3638; CR108 IN4446

Q108 2N3566; C116 7PF; R142 36K; Q109 2N3566; R118 2K; R119 36K; Q110 2N3566

+30V; R147 56K; R148 10K EXT TRIG ADJ; R149 27K; −20V

SWEEP MODE

SWEEP TRIGGER J701 — TRIGGER — S101A2 — MANUAL — 60 Hz LINE SYNC FROM T501 TERMINAL 5 (DWG 610B-500) — AUTO

C101 .1; R150 10K; R101 10K

R102 1.2K; R103 10K; R104 9.1K; R105 6.8K; −20V

Q101A 2N3566; CR101 IN458A

R106 910; C103 .001; CR103 IN458A; C104 .001; Q101B 2N3566; CR102 IN458A; R107 10K; R108 27K

Q102 2N3565

R113 43K; R112 13K; R114 5.6K; R115 27K; C105 68pf; R111 56K; * R116 360K; Q103 2N3565

R109 10K; R110 100K; −20V

CR105 FD300; CR104 IN4446

Q104 2N4303; Q105 2N3565; Q106 2N3694

R122 3.3K; R123 10K; R124 470K; C106 .001; R125 4.7K

R126 10K; R129 47K; SWEEP BIAS ADJUST; −20V

+30V; R143 39K; R144 50K; MANUAL SWEEP

R127 5K; R128 4.7K; SWEEP START LEVEL

S101 B2 — TRIG — MANO L.SYNC — AUTO — FROM S201-A2 (DWG 610B-200)

C102 3pf; R136 8.2M; S102 SWEEP TIME; C107 2µf; C108 .2µf; C109 .02µf; C110 .002µf; C111 50µf; C112 5µf; C113 .47µf; C114 .047µf

J401 PIN 8 — SEE 610B-300 — R134 100K — SWEEP VERNIER — R135 6.8K

S101 B1 — SWEEP TO PIN 5 610B-1A (DWG 610B-200)

S103 — TRIGGER — −20V

R130 7.5K; R131 5K SWEEP END LEVEL; R132 4.7K; R138 7.5K; −20V

R139 10K; R138 10K TRIGGER ADJ; TRIGGER — S101-A1 — MANUAL — LINE SYNC — AUTO; R140 18K; −20V

CR106 IN4446; C115 .02

Q107 2N3565

R137 * 150K HOLD OFF ADJ; R132 10K; R131 10K; −20V

610B-3B SWEEP GENERATOR

−20V

UNLESS OTHERWISE NOTED:
RESISTANCE IN OHMS
CAPACITANCE IN MICROFARADS
* FACTORY SELECTED VALUE

SWEEP GENERATOR

610B-100
5-5-68

PRINT: 1-68

REMOTE OR SWEPT FREQUENCY PROGRAMMING

ΔF 50K | Fo 10K | REMOTE 10K

J103 I H G F E D C B A

SWEEP | INPUT 1 | +5.6V | +11.2V | INPUT 2 | OUTPUT

R219 1.1K R220 2K +30V

J104 EXT INPUT J105

PART OF S401 MODULATION

EXT FM

C202 .02

R217 470K

END ADJUST +30V

J101 HORIZ OUT J106

610B-1A

R201 50K

R202 220 +11.2V

R203 10K

R204 820

CR201 1N4938

HORIZ CAL

R208 8.2K R209 10K R210 100K

SWEEP FROM S101 (DWG 610B-100)

R205 22K

Q201 2N3566

R212 91K

Q202 2N3566

+11.2V

+30V

R206 100K

BEGIN ADJUST

R207 15K

CR202 1N4938

R211 2.4K

CR205 1N4446

R214 150

R215 1.8K

CR203 1N4938

R218 3.3K

CR204 1N4938

R213 10K

R216 100

-20V SWEEP RIPPLE ADJUST

F1 FREQ CONTROL

F2 FREQ CONTROL

PIN 7 610B-2A

VAR FREQ MARKER

R223 2K

R221 2K

R222 2K

TO S401-C1

E2 B1 C1 D1 E1 D2 C2 B2

TO S101 A2

FREQUENCY SELECTOR S201

A1 REMOTE

F1-F2

ΔF

CW F1

CW MKR

CW F2

CW FILTER

R224 39K

P801 J401 12

C403

ΔF CAL R225 50K

+11.2V +5.6V -20V

R246 47

R247 1K

ΔF FREQUENCY R226 5K

+5.6V

+30V

610B-1A

R227 124K

R228 82.5K

Q203 2N4045

R229 187K

R230 82.5K

R235 82.5K

R236 187K

R237 113K

R232 105K

AMPLITUDE R233 5K

R234 27.4K

TRACKING R231 10K

Q204 2N3565

Q205 2N3565

R238 37.4K

CR206 1N4446

R239 8.25K

R240 37.4K

R241 37.4K

R242 27.4K

R243 10K

ΔF OFFSET

C201 .001

R244 1M

R245 1M FREQ ZERO

R248 390K

Q206 2N4249

Q208 2N3866

Q207 2N4249

FREQUENCY CONTROL ZERO R249 5K

R252 100

R250 7.5K

R251 2.4K

J401 P801 FREQUENCY CONTROL VOLTAGE

TO VARIABLE FREQUENCY MARKER PIN 2, 6, 7B 2A (DWG 610B-300)

UNLESS OTHERWISE NOTED:
RESISTANCE IN OHMS
CAPACITANCE IN MICROFARADS

FREQUENCY INSTRUCTION

610B-200
8-28-67

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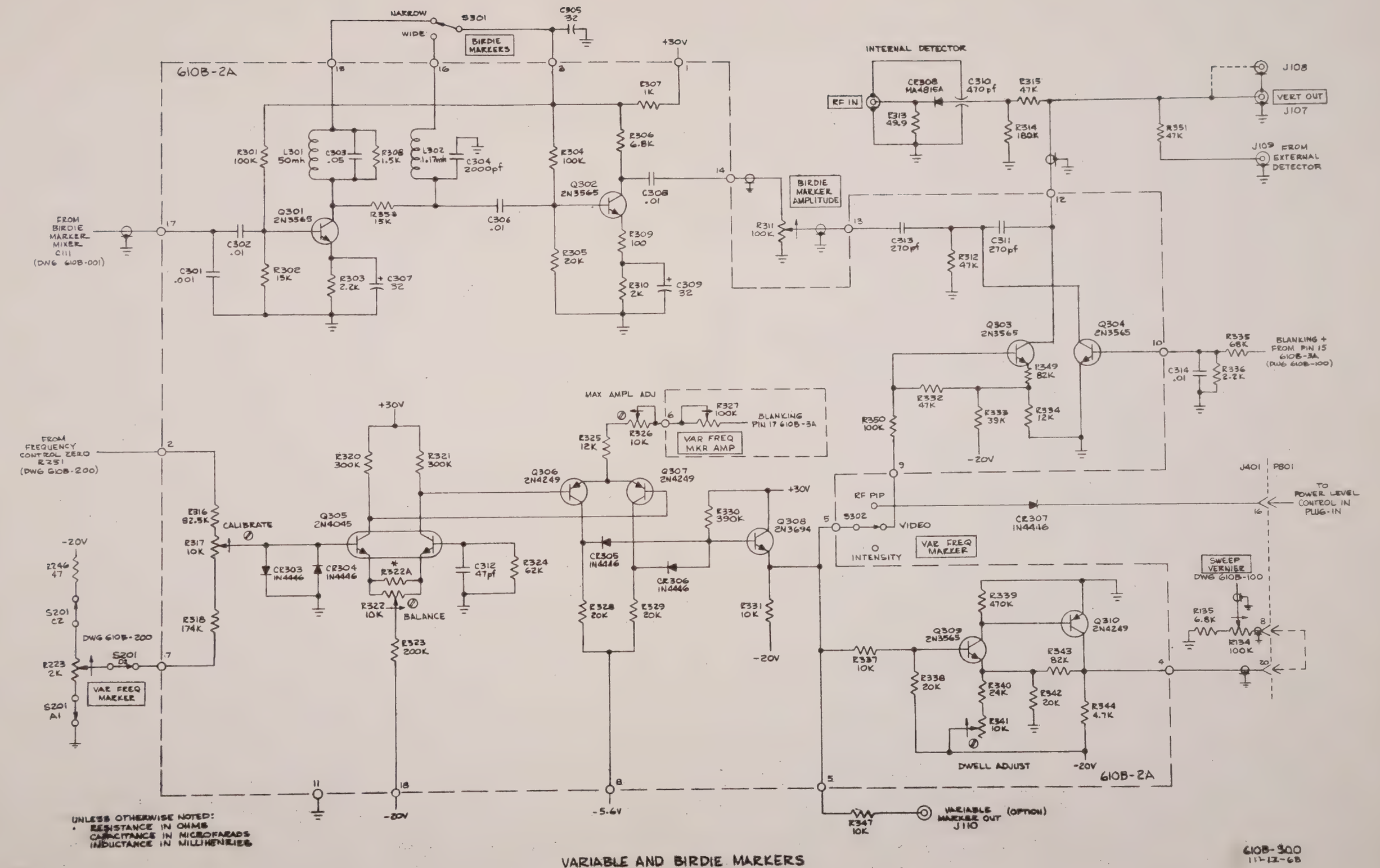
FREQUENCY INSTRUCTION



VARIABLE AND BIRDIE MARKERS

610B-300
11-12-68

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RF POWER LEVEL CONTROL

TO LEVEL DETECTOR

TO LEVEL ATTEN

NETWORK

P801 J401 PLUG-IN MODEL 610B

EXT LEVELING ADJ

R446 39K

R447 6.8K

CR407 IN4446

MARKER FROM CR307

R454 1K

R402 50K

R403 1.5K

C401 6.8

C402 6.8

-20V

BLANKING + FROM PIN 15 610B-3A

J105 EXTERNAL INPUT

J104

S401

MODULATION

NORMAL

INT AM

EXT AM

EXT FM

PWR MTR

XTAL

R452 22K

C407 .0047

R401 10K

A1 B1 B2 C2 A2 C1

R455 91K

C412 .1

R404 1K

R405 10K

C415 4.7

R458 1K

J103 PIN B (DWG 610B-200)

C202 .02

R217 470K

J401 P801

S201 E2

OTHERS CW C403

+30V

R406 100K

R407 150K

LEVEL BALANCE

R408 1K

C404 .1μf

R411 1K

Q401 2N4249

Q402 2N4249

C405 47pf

R410 15K

R409 270K

Q413 2N4249

Q414 2N4249

R456 680

R448 68K

R412 33K

R449 68K

Q403 2N3565

R413 330

R450 330K

LEVEL REGULATOR AMPLIFIER

LIMIT SENSOR

R415 36K

CR401 IN4446

R416 5.1K

R414 68K

R417 15K

Q404 2N3694

C408 .001

R418 10K

C414 220pf

Q405 2N4390

R420 120K

R421 100K

R422 270K

C406 .001

CR402 IN4446

R419 1K

UNLEVELED IF LIGHTED

DS401

BLANKING - FROM PIN 17 610B-3A (DWG 610B-100)

610B-4A

+30V

R424 9.1K

C409 .033

R453 6.2K

R425 56K

CR403 IN4446

R426 9.1K

R423 2.2K

R427 1M

1 KHz FREQ ADJ

R428 10K

CR409 IN4446

R429 2K

R457 47K

Q406 2N3565

Q407 2N3565

R430 160K

C410 .033

CR408 IN4446

R431 9.1K

R432 150K

CR404 IN4446

R433 15K

R434 5.1K

-20V

TO PIN 14 610B-3A DWG 610B-100

1 KHz INTERNAL AM OSCILLATOR

18 11

-20V

PART OF T501

CR405 IN4383

CR406 IN4383

C411A 80

R451 120K

+30V

R436 47K

R437 47K

Q410 40422

R438 47

R435 15

Q408 2N3988

Q409 2N3988

R441 200K

C413 .001

R442 15K

R443 110K

R440 120K

R439 1.5K

Q411 40354

Q412 40354

R445 62K

R444 30K

J401 P801

C411B 40

HV +40V TO +140V

R801 *

PROGRAMS HV FOR PLUG-IN

610B-4A

PROGRAMMABLE HIGH VOLTAGE REGULATOR

UNLESS OTHERWISE NOTED:
RESISTANCE IN OHMS
CAPACITANCE IN MICROFARADS

LEVEL REGULATOR AND HIGH VOLTAGE REGULATOR

LEVEL REGULATOR AND HIGH VOLTAGE REGULATOR

610B-400
5-17-68

PRINT: 1-69

TO S101A2
(DWG 610B-100)

T501

C513 .01

CR501 IN4383(x4)

R502 1

CR502

CR503

CR504

C503 1000

R533 10K

R503 1

Q501 2N3055

R505 3K

CR512 IN4749

CR511 IN4446

CR510 IN4446

R506 27K

R507 27K

CR509 IN4446

Q502 2N4355

C508 .1

R514 36 *

R504 1K

Q503 2N3569

Q504 2N3569

R509 3.9K

R508 15K

CR513 IN4446

R512 50K

+30V ADJ

R511 27.4

R510 3740

C505 6.8

Q505 TD100

R513 2210

CR514 IN4446

R515 11K

R516 1.5K

R535 3K

+11.2V

R536 50K

+11.2V ADJ

R537 4420

R539 1K

C515 .047

R541 1.5K

C517 32

R543 400

Q506 UA709

R538 510

CR523 IN4446

C516 200pf

Q512 2N2218

R542 2K

C514 10

CR521 IN823

R540 1240

C518 10

J401 P801 13 +30V

+30V

C511 .1

+11.2V

J401 P801 10 GND

R501 47K

C501 .01

DS501

G502

115V

230V

F501 .8A SB

P501

C502 .01

SCHEMATIC DWG 610B-400

R521 30K

R547 1.5K

Q513 2N4249

R544 5620

R549 510

+5.6V

R545 500

+5.6V ADJ

Q514 2N3565

Q515 2N3565

R546 5620

R548 2.4K

R550 2.7K

C521 .1

CR505 IN4383(x4)

R517 1

R518 1

Q507 2N3055

CR506

CR507

CR508

C506 1000

R534 10K

R520 8.2K

CR516 IN4446

R529 100

C510 .1

CR515 IN4446

Q508 2N4355

R519 1.5K

Q509 2N3569

Q510 2N3569

R522 56K

CR517 IN4446

CR518 IN4446

R523 15K

-20V

+30V

R524 50K

-20V ADJ

R525 9090

R526 22.1K

C509 6.8

Q511 TD100

R531 2K

CR519 IN823

C519 10

R552 5620

R554 1.2K

CR520 IN4446

Q516 2N4249

J401 P401 10 -5.6V

R527 3400

R528 1K

R530 13K

R532 1.5K

R551 28.7K

R553 27.4K

R555 1K

C520 32

C512 .1

-20V

J401 P401 22 -20V

610B-5B

POWER SUPPLIES

UNLESS OTHERWISE NOTED:
RESISTANCE IN OHMS
CAPACITANCE IN MICROFARADS
* FACTORY SELECTED VALUE

MODEL 6104

PLUG-IN (100 kHz - 100 MHz)

INSTRUCTION MANUAL

TABLE OF CONTENTS
(Also see 610B MANUAL)

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1-1 GENERAL
1-2 R. F. FREQUENCY GENERATOR
1-3 POWER AMPLIFIER
1-4 FREQUENCY CONTROL

RECALIBRATION PROCEDURE — SECTION 2

2-1 INPUT REQUIRED FROM THE 610B MAIN FRAME
2-2 R. F. AMPLIFIER GAIN TEST
2-3 MULTIPLIER MIXER and LEVEL CONTROL RECALIBRATION
2-4 FREQUENCY ZERO RECALIBRATION
2-5 ADJUSTMENTS
2-6 6104 TROUBLE SHOOTING CHART

PARTS LIST — SECTION 3

SCHEMATICS and FLOW DIAGRAM — SECTION 4

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WILTRON COMPANY
for better electronics measurements

930 EAST MEADOW DRIVE
PALO ALTO, CALIFORNIA 94303
Telephone: (415) 321-7428

SECTION 1

MODEL 6104 PLUG - IN
THEORY OF OPERATION

1-1 GENERAL

The Model 6104 covers the R. F. band of 100 kHz to 100 MHz using a heterodyne technique. See the 6104 Flow Diagram. A fixed frequency of 400 MHz is mixed with a variable 400 to 500 MHz swept frequency to generate the desired R. F. This signal is increased to 2v rms in the power amplifier where the level detector is located. Level control is applied to the 400 MHz signal and a leveled 1v rms is delivered to the 50 ohm output. Refer also to the Theory of Operation of the Model 610B Main Frame.

1-2 R. F. FREQUENCY GENERATOR

The 400 MHz fixed frequency is derived from a multiplier chain consisting of Q601 50 MHz crystal oscillator, Q602 x2 multiplier and buffer and Q603 x4 multiplier. See schematic 6104-600. A resistance coupled four section filter delivers a pure 400 MHz signal to the balanced mixer CR-602 and CR603. The bias current of the x4 multiplier is varied to achieve level control.

The swept oscillator, Q625, has voltage applied through R626 to the varactor diode, CR625, which tunes L625 to generate 400 to 500 MHz. The amplifiers Q625, 626 and 627 isolate the oscillator from the output and raise the signal level. The swept oscillator output is applied through the balun, L613 and L612 to give balanced drive to the mixer. The configuration of the mixer produces low distortion and spurious frequency levels. The desired output is coupled through Q604 to a 50 ohm output line and then to the power amplifier.

1-3 POWER AMPLIFIER

The input signal passes through a 120 MHz low pass filter to drive through stages of common emitter gain, Q701, 2 and 3. Two emitter followers, Q703 and 4 provide power gain to deliver 2 volts rms to R726. This is attenuated to the emitter follower, Q706, and coupled through a rear connector to the birdie mixer. This same signal is sampled through R723, see schematic 6104-700, to the doubling detector CR701, CR702. The R. F. Power Level Venier attenuates the detector output to the 610B level regulator to produce a nominal 3db increase in the output R. F. The level loop is completed through the x4 multiplier which functions as a voltage controlled attenuator.

The action of the level loop is to maintain the voltage constant at the output of Q708 regardless of load variations; hence, a zero impedance source is created. A 50 ohm resistor, R726, is added in series to give a 50 ohm source impedance and reduces the output to 1 volt rms. The R. F. passes through a 10db step attenuator to the output jack. One db level step is achieved by stepping the level reference voltage with the R. F. Power Level Control, see schematic 6104-800. The level loop follows modulation to above 1kHz and then rolls off rapidly to a loop crossover at about 20 kHz.

1-4 FREQUENCY CONTROL

The FREQUENCY CONTROL circuit shapes the input 10 volt ramp to a non-linear output of about 30 volts in the manner described in the 610B theory of operation. The control loop will handle FM rates up to 2 kHz; beyond this, its performance falls rapidly to a 30 kHz loop crossover frequency.

SECTION 2

6104 PLUG-IN
RECALIBRATION PROCEDURE

2-1 INPUT REQUIRED FROM THE 610B MAIN FRAME

In order to have an accurately calibrated plug-in unit, the input voltages and waveforms from the 610B Main Frame must be correct. The table on the next page lists the important voltages and waveforms found at J401, the input to the plug-in located on the 610B rear panel. If the signal is incorrect or out of tolerance, the reference given along with each signal directs the operator to the appropriate section of the Recalibration Procedure. As a further aid in Recalibration, a simplified signal flow diagram (Fig. 2D) shows the major stages of the 6104 and the important voltages and waveforms indicated. Prior to checking the inputs from the Main Frame, make the front panel control settings as indicated in the opposite column. Allow 15 minutes warm-up time before making any measurements or adjustments.

610B/6104 FRONT PANEL CONTROL SETTINGS

FREQUENCY SELECTOR F1 to F2

RETRACE RF - OFF

F1 Frequency Control - 0

F2 Frequency Control - 100 MHz

SWEEP MODE - AUTO

SWEEP TIME - 1.0 - 0.1 sec.

SWEEP TIME VERNIER - FULL CW

MODULATION - NORMAL

VAR FREQ MARKER - INTENSITY

VAR FREQ MARKER AMP - FULL CCW

RF POWER LEVEL ATTENUATOR - 0 dbm (10 db per step)

RF POWER LEVEL - +3 dbm

RF POWER LEVEL VERNIER-CALIBRATE

Recalibration Procedure - cont'd.

TABLE 2A

c) Voltages and Waveforms on J401 with the 610B/6104 front panel controls set as indicated on the previous page.

PIN NO.	VOLTAGE OR WAVEFORM	RECALIBRATION REFERENCE
2	PROGRAMMED HIGH VOLTAGE, +80V d.c. ±5%	610B Section 7-2
6	Level control voltage -2V to -10V d.c. nominal range +2V to -18V d.c. maximum range	6104 Section 2-3
10	-5.6 V d.c.	610B Section 7-2
13	+30V d.c. ±10 mv	610B Section 7-2
15	Negative blanking to VCO +30 V during sweep, 0 V during retrace.	610B Section 7-17
16	External level control reference voltage -0.2V to -0.4V d.c. nominal range	6104 Section 2-6
18	Level Detector Output Voltage -0.2V to -0.4V d.c. nominal range	6104 Section 2-2 6104 Section 2-3
19	Level Regulator Reference Voltage -0.2V to -0.4V d.c. nominal range	6104 Section 2-3
22	-20V d.c. ±10 mv	610B Section 7-2
24	Sweep Waveform, see Fig. 7C in Sec. 7	610B Section 7-5

Recalibration Procedure - cont'd.

2-2 R. F. AMPLIFIER GAIN TEST

a) Connect the output of the RF Signal Generator, described in the Required Test Equipment Section, to J701 the RF Amplifier input in the 6104. Set the Signal Generator frequency to 10 MHz.

b) Connect the RF power meter described in the Required Test Equipment Section to the RF output connection on the 6104 front panel.

c) With the 6104 front panel controls set as described previously in Section 2-1, Col. 2 adjust the signal level output of the Signal Generator to give a +3 dbm power level indication.

d) The minimum acceptable gain of the amplifier is 39 db. To calculate the gain of the amplifier, subtract the output of the signal generator in dbm from +13 dbm. For example, if the output of the signal generator is -28 dbm then the gain of the amplifier is +41 db.

e) Repeat steps a through d at 20, 40, 60, 80, and 100 MHz. The minimum gain at all frequencies is 39 db.

f) There are no gain adjustments in the 6104 RF amplifier, if the minimum gain is not met at any frequency see the 6104 Trouble Shooting Chart for steps to remedy the situation.

2-3 MULTIPLIER MIXER and LEVEL CONTROL RECALIBRATION

a) Set F1 to 20 MHz.
Set F2 to 100 MHz.
Set RETRACE RF to ON.
Set all other controls as described in preceding Section 2-1, Col. 2.
Connect the power meter to the R. F. output of the 6104. The power meter should read +3 dbm ±0. 3 db.

b) Connect 610B/6104 and a d. c. oscilloscope as shown in Fig. 2A.

Set all 610B/6104 controls as described in preceding Section 2-1, Col. 2.

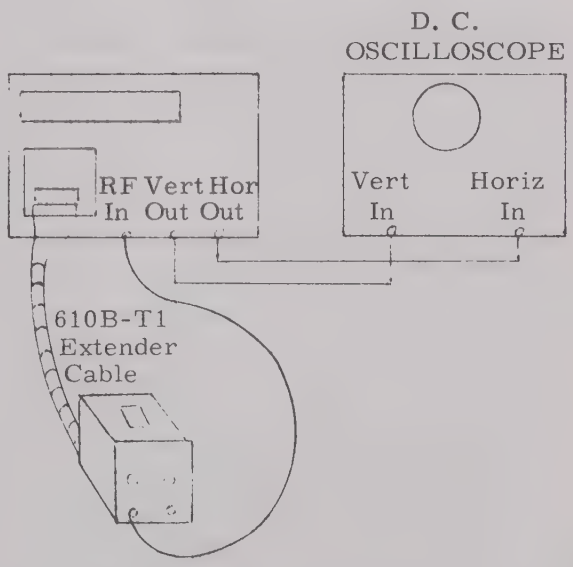


FIGURE 2A
610B/6104 RECALIBRATION CONFIGURATION

Adjust the vertical sensitivity of the d. c. oscilloscope so that a change in the RF Power Level Control from + 3 dbm to + 2 dbm will produce a change of 1 cm on the vertical scale of the oscilloscope graticule. This calibrates the oscilloscope to 1 db/cm at the + 3 dbm output of the 6104.

Recalibration Procedure - cont'd.

MULTIPLIER MIXER and LEVEL CONTROL RECALIBRATION -continued-

c) Observing the video signal of the detected RF output on the oscilloscope, turn the 1 db step RF Power Level switch on the 6104 through its entire range. Check the video signal for a leveled condition with no more than 0.3 db of level variation from 1 to 100 MHz on all positions. Also check to see that the unleveled condition light on the 610B Front panel stays off.

d) Turn the RF Power Level switch on the 6104 to + 3 dbm. Turn the RF Power Level Vernier full CW and observe a minimum of 1 db increase in video signal across the frequency band.

e) If any of the above conditions are not met, see Section 2-5 for adjustment procedures.

2-4 FREQUENCY ZERO RECALIBRATION

Before recalibration of the frequency zero is attempted the sweep signal on Pin 24 of J401 should be rechecked as described in TABLE 2A. If this waveform is incorrect, the frequency control circuits will not respond properly and any adjustment of them will put the instrument farther out of calibration than it already is.

a) Set F1 frequency control - 0
Set F2 frequency control - 10 MHz
Set all other controls as described in Section 2-1, Column 2.
Connect the 610B/6104 and d.c. oscilloscope as shown in Figure 2A.
Turn on the 1 MHz Harmonic Marker Generator and adjust the MARKER AMPLITUDE until the markers are visible.

b) Adjust the oscilloscope Horizontal sensitity for a 10 cm horizontal trace. The video presentation on the oscilloscope should show the zero frequency signal and the 10 1 MHz harmonic markers corresponding to a 1 to 10 MHz frequency sweep. See Figure 2B for a representation of the desired display.

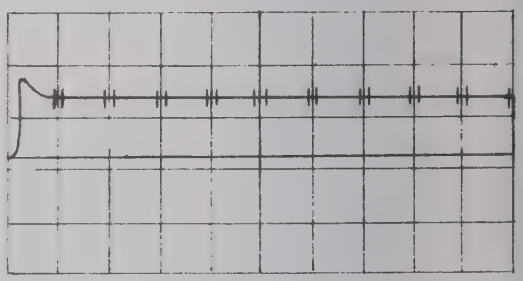


Figure 2B

0 to 10 MHz Sweep with 1 MHz Harmonic Markers as seen on an oscilloscope with a rectangular graticule.

c) If the zero frequency point is not at the left end of the trace when all the controls are properly set, the ZERO FREQUENCY ADJUST R811 in the 6104 can be adjusted to set the zero frequency at the start of the sweep.

ecalibration Procedure - cont'd.

5 ADJUSTMENTS

a) Multiplier Mixer Tuning

SET MODULATION to XTAL. Set all other controls as described in Section 2-1, Column 2. Connect the 610B/6104 and oscilloscope as shown in Figure 2A.

1. Observe the detected R.F. signal displayed on the d.c. oscilloscope. The waveform should appear similar to Figure 2C. This is the unleveled output of the 6104. There should be a monotonic fall off of gain with frequency.

2. The dotted line in Figure 2C indicates a mistuned multiplier mixer; this waveform may be adjusted by tuning C620 on the 6104 deck.

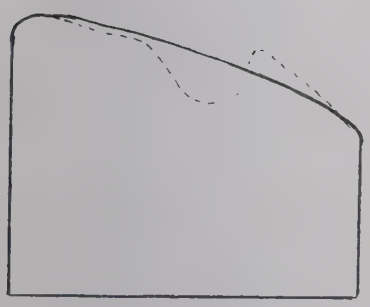


Figure 2C

UNLEVELED OUTPUT FROM THE 6104

3. Only if there is an output problem tune C620, C623, C624, C625 and C626 located on the 6104 main deck for a maximum amplitude signal as shown in Figure 2C. C607 and C615 relate to the 50 MHz oscillator and should not be adjusted as long as the oscillator is working properly.

b) Level control adjustment

Set all controls as described in Section 2-1, Column 2.

1. Short the wiper of S801 (the 1db step RF POWER LEVEL control) to ground with clip lead.

2. Short the junction of R715 (1K) and R728 (10K) located on the 6104-1 Printed Card to ground with clip lead.

3. Connect the .02% d.c. voltmeter to Pin 6 of J401 located on the rear panel of the 610B.

4. Adjust the LEVEL BALANCE control on Printed Card 610B-4A of the 610B for 0V ±.5V on the voltmeter.

5. Remove clip leads.

c) LEVEL CAL. adjust

Set F1 - 20 MHz
Set F2 - 100 MHz
Set RETRACE RF - ON
Set all other controls as described in Section 2-1, Column 2.
Connect power meter to the RF output of the 6104. The power meter should read +3 dbm. If it does not, adjust R839 LEVEL CAL in the 6104 for a reading of + 3 dbm ±0.1 db.

6104 TROUBLE SHOOTING CHART

GENERAL

INDICATION	POSSIBLE CAUSE AND REMEDY
No RF OUTPUT or unleveled RF OUTPUT	a) Check front panel control settings. See Section 2-1, Column 2. b) Defective output from 610B main frame. Check voltages and waveforms indicated in Table 2 A. c) RF Amplifier defective. See Section 2-2. d) Voltage controlled oscillator defective. Check for +9 dbm ±1 db output from VCO located on the rear panel of the 6104. e) Multiplier Mixer stage defective. Check for -24 dbm ±1 db output from the multiplier mixer assembly with the VCO input to the mixer disconnected. See Section 2-3 for recalibration procedure.
No Horizontal Sweep	a) See 610B Trouble Shooting Chart
RF POWER LEVEL CONTROL and POWER LEVEL VERNIER have no control over the RF output	a) Check front panel control settings. See Section 2-1, Col. 2. b) Defective level control voltage check voltages and waveforms indicated in Table 2 A.
No RF Pip	a) See 610B Trouble Shooting Chart
RF Amplifier has low gain or no output signal	a) Check output of VCO and multiplier mixer stages. See NO RF output above. b) Check d. c. supply voltages. See Table 2 A. c) Replace Q705. d) Replace other transistors in the RF amplifier starting with Q704.

6104 TROUBLE SHOOTING CHART

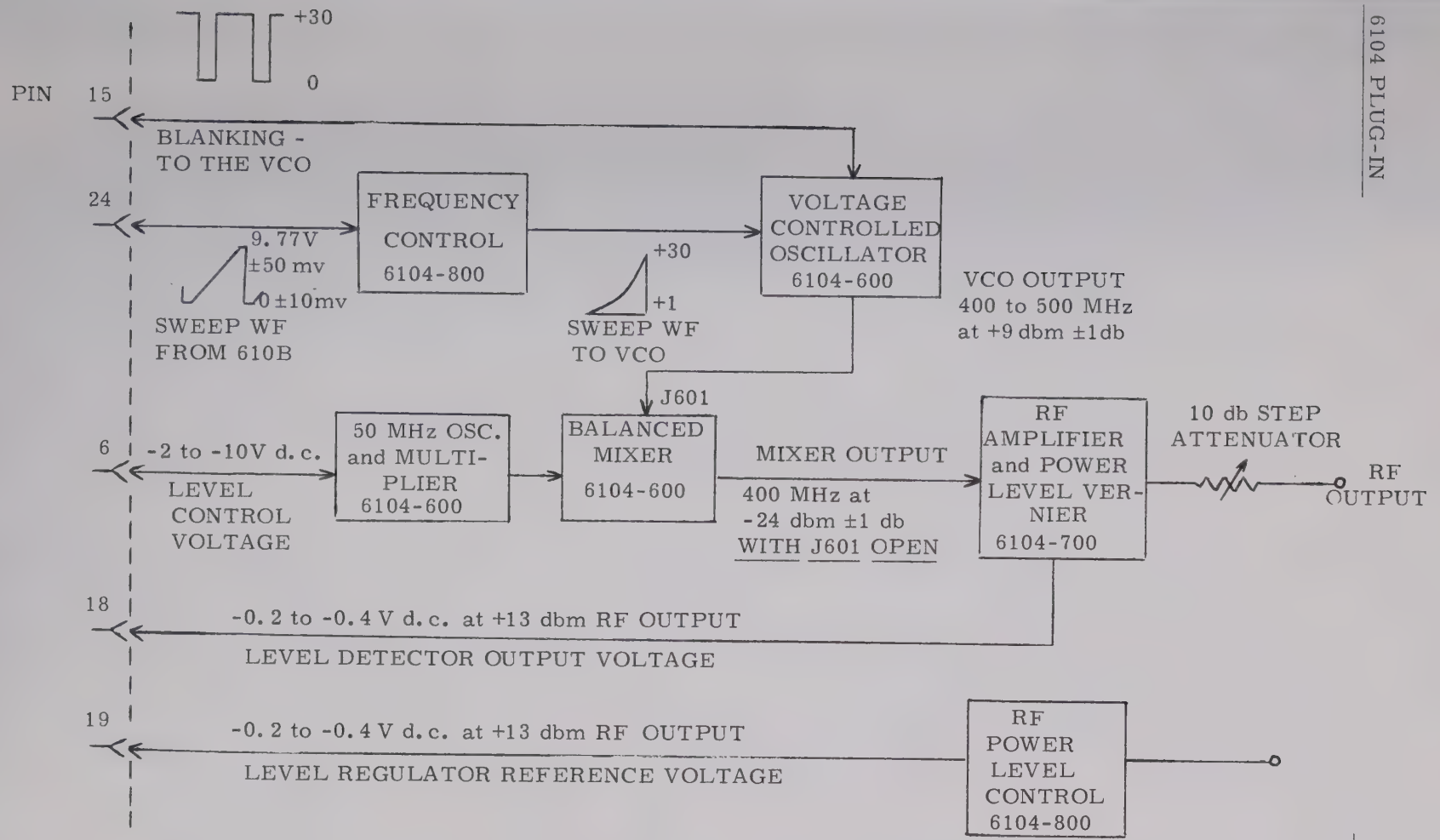
GENERAL Cont'd.

INDICATION	POSSIBLE CAUSE AND REMEDY
No output from Multiplier Mixer Stage	a) 50 MHz oscillator inoperative, tune C607 and C615 on the 610B main deck to start oscillator operation. b) Check d. c. conduction of all transistors in the Multiplier Mixer Assembly. c) Check for -18V on Pin 6 of J401. If this voltage is absent or is a positive value, see No Level Control output voltage in the 6104 Trouble Shooting Chart.
No output from the Voltage Controlled Oscillator	a) Check sweep input to VCO. See 6104 signal flow diagram 2 D. b) Check blanking into VCO at Pin 15 of J401. See Table 2 A. c) Check d. c. conduction of VCO Transistors.
Level light on 610B front panel stays on	a) Check front panel control settings. See Section 2-1, Column 2. b) Cables unhooked in the 6104 or improperly connected. c) Adjust 610B LEVEL BALANCE control. See Section 2-3.
Cannot adjust RF output to +13 dbm with LEVEL CAL control	a) Check control settings. See Section 2-3 (a). In particular be sure the RETRACE RF switch is ON. b) Check the outputs of the RF amplifier. Voltage controlled oscillator and Multiplier Mixer stages. See Section 2 - 2 and No RF output above in the Trouble Shooting Chart. c) Check setting of 610B LEVEL BALANCE control. See Section 2-3.

6104 TROUBLE SHOOTING CHART

GENERAL Cont'd.

INDICATION	POSSIBLE CAUSE AND REMEDY
Cannot adjust 610B LEVEL BALANCE control	a) Make sure the proper points in the 6104 are grounded. See Section 2-3. b) Check Q401 and Q402 located on the 610B-4A Printed card for balanced conduction when the LEVEL BALANCE control is in the center of its range. c) Check all other transistors in the level regulator circuit for d.c. conduction.



NOTES:

1. All 610B/6104 controls are set as stated in Section 2-1, Column 2.
2. Numbers inside boxes indicate appropriate 6104 schematic numbers.

FIGURE 2 D

SIMPLIFIED SIGNAL FLOW DIAGRAM FOR THE 6104

Resistors

R601	4.7K	1/4W	5%	Fixed	Comp
R602	43K	1/4W	5%	Fixed	Comp
R603	39K	1/4W	5%	Fixed	Comp
R604	4.7K	1/4W	5%	Fixed	Comp
R605	560	1/4W	10%	Fixed	Comp
R606	820	1/4W	10%	Fixed	Comp
R607	3.9K	1/4W	5%	Fixed	Comp
R608	3.9K	1/4W	5%	Fixed	Comp
R609	3.9K	1/4W	5%	Fixed	Comp
R610	330	1/4W	10%	Fixed	Comp
R611	330	1/4W	10%	Fixed	Comp
R612	330	1/4W	10%	Fixed	Comp
R613	330	1/4W	10%	Fixed	Comp
R614	56	1/4W	5%	Fixed	Comp
R615	56	1/4W	5%	Fixed	Comp
R616	56	1/4W	5%	Fixed	Comp
R617	2.4K	1/4W	5%	Fixed	Comp
R618	2.2K	1/4W	5%	Fixed	Comp
R626	10K	1/4W	10%	Fixed	Comp
R627	5.6K	1/4W	10%	Fixed	Comp
R628	3K	1/4W	5%	Fixed	Comp
R629	2.7K	1/4W	5%	Fixed	Comp
R630	3.9K	1/4W	5%	Fixed	Comp
R631	4.3K	1/4W	5%	Fixed	Comp
R632	3K	1/4W	5%	Fixed	Comp
R633	2.7K	1/4W	5%	Fixed	Comp
R634	3K	1/4W	5%	Fixed	Comp
R635	100			Var	Comp
R701	51	1/4W	5%	Fixed	Comp
R702	13K	1/4W	5%	Fixed	Comp
R703	4.3K	1/4W	5%	Fixed	Comp
R704	2.2K	1/4W	5%	Fixed	Comp
R705	240	1/4W	5%	Fixed	Comp
R706	1.3K	1/4W	5%	Fixed	Comp
R707	43K	1/4W	5%	Fixed	Comp
R708	6.8K	1/4W	5%	Fixed	Comp
R709	2.2K	1/4W	5%	Fixed	Comp
R710	330	1/4W	5%	Fixed	Comp
R711	6.2K	1/4W	5%	Fixed	Comp
R712	2.2K	1/4W	5%	Fixed	Comp
R713	120	1/4W	5%	Fixed	Comp

Resistors

R714	1.5K	1/4W	5%	Fixed	Comp
R715	~~1K~~ 2.2K	1/4W	10%	Fixed	Comp
R716	8.2K	1/4W	5%	Fixed	Comp
R717	30K	1/4W	5%	Fixed	Comp
R718	1K	1/2W	5%	Fixed	Comp
R719	220	2W	5%	Fixed	Comp
R720	2K	1/4W	5%	Fixed	Comp
R721	1.5K	1/2W	10%	Fixed	Comp
R722	1.3K	1/4W	5%	Fixed	Comp
R723	360	1/4W	5%	Fixed	Comp
R724	1K			Var	WW
R725	~~3K~~ 2K	1/4W	5%	Fixed	Comp
R726	49.9	1/4W	1%	Fixed	Film
R727	47ohms	1/4W	5%	Fixed	Comp
R728	10K	1/4W	5%	Fixed	Comp
R729	820Ω	1/4W	5%	Fixed	Comp
R801	91K	1/4W	5%	Fixed	Comp
R802	270K	1/4W	5%	Fixed	Comp
R803	620K	1/4W	5%	Fixed	Comp
R804	3.3K	1/4W	5%	Fixed	Comp
R805	3.3K	1/4W	5%	Fixed	Comp
R806	8.2K	1W	5%	Fixed	Comp
R807	10K	1/4W	5%	Fixed	Comp
R808	270	1/4W	10%	Fixed	Comp
R809	20K	1/8	1%	Fixed	Film
R810	10K	1/8	1%	Fixed	Film
R811	10K			Var	WW
R812	10K	1/8W	1%	Fixed	Film
R813	2.74K	1/8W	1%	Fixed	Film
R814	10K	1/4W	1%	Fixed	Film
R815	10K	1/4W	1%	Fixed	Film
R816	240K	1/4W	5%	Fixed	Comp
R817A	Factory selected value			Fixed	Comp
R817B		1/4W		Fixed	Comp
R817C		1/4W		Fixed	Comp
R817D		1/4W		Fixed	Comp
R817E		1/4W		Fixed	Comp
R817F		1/4W		Fixed	Comp
R817G		1/4W		Fixed	Comp
R817H		1/4W		Fixed	Comp
R817I		1/4W		Fixed	Comp

Resistors

R817J		1/4W		Fixed	Comp
R818	2K	1/4W	1%	Fixed	Film
R819	100	1/8W	1%	Fixed	Film
R820	118	1/8W	1%	Fixed	Film
R821	105	1/8W	1%	Fixed	Film
R822	182	1/8W	1%	Fixed	Film
R823	162	1/8W	1%	Fixed	Film
R824	169	1/8W	1%	Fixed	Film
R825	191	1/8W	1%	Fixed	Film
R826	237	1/8W	1%	Fixed	Film
R827	215	1/8W	1%	Fixed	Film
R828	205	1/8W	1%	Fixed	Film
R829	294	1/4W	1%	Fixed	Film
R830	43.2	1/4W	1%	Fixed	Film
R831	48.7	1/4W	1%	Fixed	Film

Resistors

R832	54.9	1/4W	1%	Fixed	Film
R833	61.9	1/4W	1%	Fixed	Film
R834	68.1	1/4W	1%	Fixed	Film
R835	76.8	1/4W	1%	Fixed	Film
R836	86.6	1/4W	1%	Fixed	Film
R837	97.6	1/4W	1%	Fixed	Film
R838	110	1/4W	1%	Fixed	Film
R839	5K			Var	WW
R840	10K	1/4W	5%	Fixed	Comp
R841	6.8K	1/4W	5%	Fixed	Comp
R842	240	1/4W	5%	Fixed	Comp
R843	10K	1/4W	5%	Fixed	Comp
R844	1K	1/4W	10%	Fixed	Comp
R845	10K	1/4W	10%	Fixed	Comp
R846	4.42K	1/8W	1%	Fixed	Film

Capacitors

C601	1000pf	Feed-thru		Fixed	Ceram
C602	1000pf	Feed-thru		Fixed	Ceram
C603	1000pf	Feed-thru		Fixed	Ceram
C604	1000pf	Feed-thru		Fixed	Ceram
C605	100pf	500V	5%	Fixed	Mica
C606	7pf	500V	5%	Fixed	Mica
C607	0.5-3pf			Var	Ceram
C608	27pf	500V	5%	Fixed	Mica
C609	1000pf	500V	Feed-thru	Fixed	Ceram
C610	1000pf	500V	Feed-thru	Fixed	Ceram
C611	1000pf	500V	Feed-thru	Fixed	Ceram
C612	1000pf	500V	Feed-thru	Fixed	Ceram
C613	56pf	500V	5%	Fixed	Mica
C614	10pf	500V	5%	Fixed	Mica
C615	0.5-3pf			Var	Ceram
C616	1000pf	500V	Feed-thru	Fixed	Ceram
C617	1000pf	Feed-thru		Fixed	Ceram
C618	1000pf	Feed-thru		Fixed	Ceram
C619	1000pf	Feed-thru		Fixed	Ceram
C620	0.5-3pf			Var	Ceram
C621	1pf	500V	5%	Fixed	TiO_2
C622	22pf	500V	5%	Fixed	Mica
C623	1-6pf			Var	Ceram

Capacitors

C624	1-6pf			Var	Ceram
C625	1-6pf			Var	Ceram
C626	1-6pf			Var	Ceram
C627	1000pf	500V	Feed-thru	Fixed	Ceram
C628	6.8μf	35V		Fixed	Elect
C629	6.8μf	35V		Fixed	Elect
C630	.1μf	10V		Fixed	Ceram
C631	6.8μf	35V		Fixed	Elect
C632	5pf	500V	5%	Fixed	Mica
C633	5pf	500V	5%	Fixed	Mica
C634	5pf	500V	5%	Fixed	Mica
C635	5pf	500V	5%	Fixed	Mica
C636	1000pf	500V	Feed-thru	Fixed	Ceram
C637	3.3μf	500V	5%	Fixed	TiO_2
C638	47pf	500V	5%	Fixed	Mica
C639	.68pf	500V	5%	Fixed	TiO_2
C640	1000pf	500V	Feed-thru	Fixed	Ceram
C641	1000pf	500V	Feed-thru	Fixed	Ceram
C642	1000pf	500V	Feed-thru	Fixed	Ceram
C643	47pf	500V	5%	Fixed	Mica
C644	47pf	500V	5%	Fixed	Mica
C645	1000pf		Feed-thru	Fixed	Ceram

Capacitors

C646	1000pf	Feed-thru		Fixed	Ceram
C647	47pf	500V	5%	Fixed	Mica
C648	.001µf	1KV	10%	Fixed	Ceram
C701	43pf	500V	5%	Fixed	Mica
C702	43pf	500V	5%	Fixed	Mica
C703	43pf	500V	5%	Fixed	Mica
C704	560pf	500V	5%	Fixed	Mica
C705	390pf	500V	5%	Fixed	Mica
C706	56pf	500V	5%	Fixed	Mica
C707	6.8µf	35V		Fixed	Elect
C708	6.8µf	35V		Fixed	Elect
C709	390pf	500V	5%	Fixed	Mica
C710	82pf	500V	5%	Fixed	Mica
C711	6.8µf	35V		Fixed	Elect
C712	6.8µf	35V		Fixed	Elect
C713	.001µf	1KV	10%	Fixed	Ceram
C714	39pf	500V	5%	Fixed	Mica
C715	.001µf	1KV		Fixed	Ceram
C716	.1µf	10V		Fixed	Ceram
C717	.1µf	10V		Fixed	Ceram
C718	.1µf	10V		Fixed	Ceram
C719	.01µf	500V	20%	Fixed	Ceram
C720	.01µf	500V	20%	Fixed	Ceram
C721	.0047µf	500V	20%	Fixed	Ceram
C722	6.8µf	35V		Fixed	Elect
C801	.390pf	500V	5%	Fixed	Mica
C802	.02µf	500V	20%	Fixed	Ceram
C803	100pf	500V	5%	Fixed	Mica
C804	7pf	500V	5%	Fixed	Mica
C805	.01µf	500V	20%	Fixed	Ceram
C806	1000pf	125V	5%	Fixed	Poly
C807	.0047µf	500	5%	Fixed	Ceram
C808	.0047µf	500	5%	Fixed	Ceram
C809	.01µf	500	5%	Fixed	Ceram
C810	.0047µf	500	5%	Fixed	Ceram
C811	150pf	500	5%	Fixed	Mica
C812	150pf	500	5%	Fixed	Mica

Inductors

L601	1.0µh	Fixed
L602	10µh	Fixed
L603	.33µh	Fixed
L604	10µh	Fixed
L605	Wiltron No. M6104/A	Fixed
L606	10µh	Fixed
L607	Wiltron No. M6104/B	Fixed
L608	Wiltron No.	Fixed
L609	Wiltron No.	Fixed
L610	Wiltron No.	Fixed
L611	10µh	Fixed
L612	Wiltron No. M6104/H	Fixed
L613	Wiltron No. M6104/I	Fixed
L614		Fixed
L625	Wiltron No. M6104/A	Fixed
L626	Wiltron No. M6104/C	Fixed
L627	Wiltron No. M6104/C	Fixed
L701	.05µh Wiltron No. M6104/D	Fixed
L702	.1µh Wiltron No. M6104/E	Fixed
L703	.1µh Wiltron No. M6104/E	Fixed
L704	.05µh Wiltron No. M6104/D	Fixed
L705	10µh	Fixed
L706	1µh	Fixed
L707	Wiltron No. M6104/F	Fixed
L708	1µh	Fixed
L709	Wiltron No. M6104/G	Fixed

Transistors

Q601	2N3563	Q625	2N3563
Q602	2N3563	Q626	2N3563
Q603	2N3563	Q627	2N3563
Q604	2N3563		

Transistors

Q701	2N3563
Q702	2N3563
Q703	2N3563
Q704	2N3563
Q705	2N3866
Q706	2N3563
Q801	2N4249
Q802	2N3568
Q803	2N4045
Q804	2N3565

Crystals

Y601	50MHz

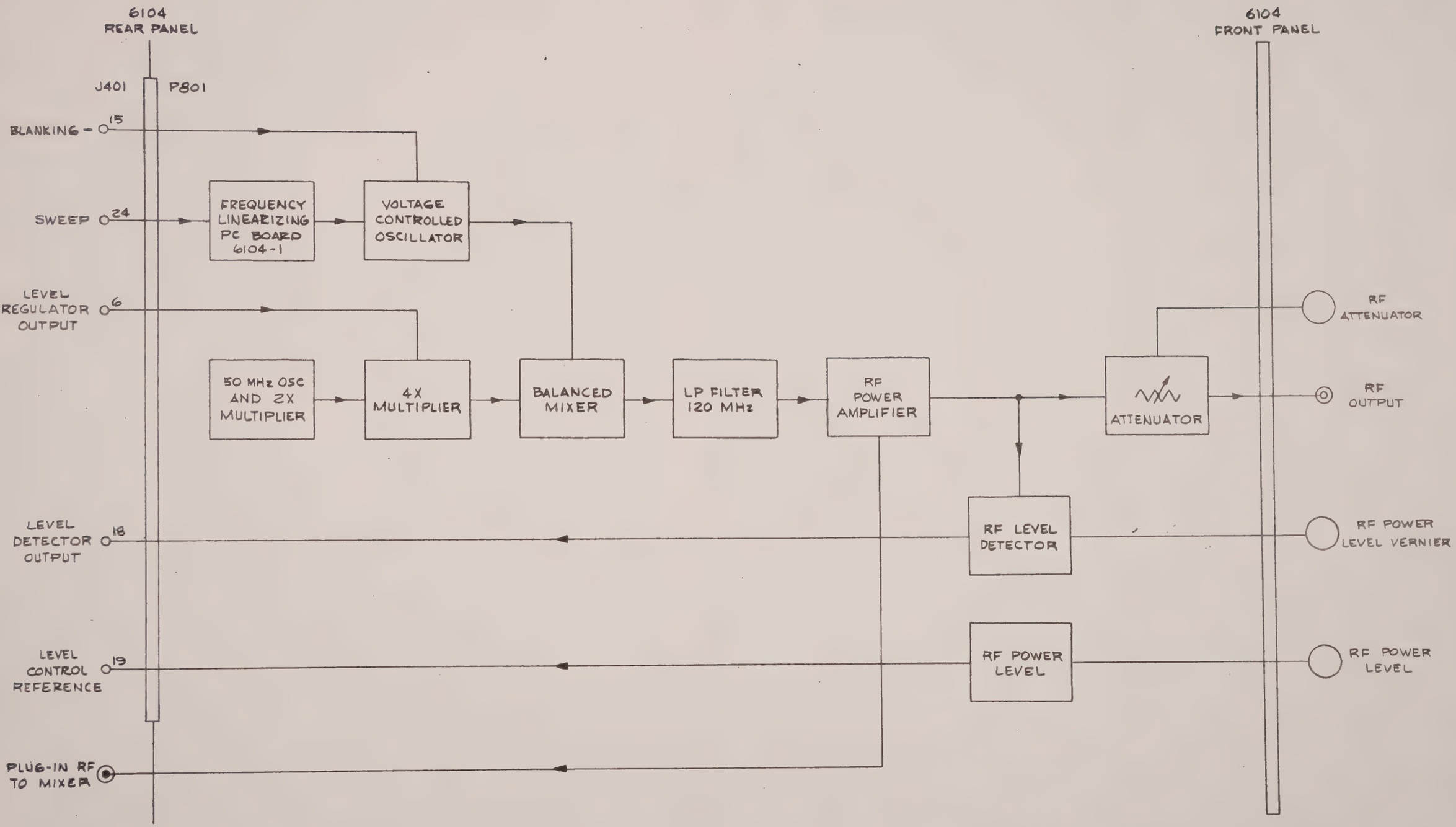
Diodes

CR601	1N755	CR701	1N82A
CR602	HPA2900	~~CR702~~	~~1N82~~A
CR603	HPA2900		
		CR801	A-J 1N4446
CR625	1N5139A	CR802	1N4446
		CR803	1N4446

Miscellaneous

J703	UG 909/U	
P801	Amphenol	26-159-24
10db Step Alternator		Telonic RA51
LATCH	SOUTHCO	48-10-101-10

RF cables Wiltron No. 6104-S-755



6104 FLOW DIAGRAM

6104 FLOW DIAGRAM

50 MHz OSCILLATOR

MULTIPLIERS

×2

×4

400 MHz TRAPS

MIXER

+30V

C601 1000
R604 4.7K
C609 1000
C618 1000
L611 10
C627 1000
R602 43K
R609 3.9K
C619 1000
C602 1000
C613 56
CR601
C605 100
IN755 (7.5V)
L605
C622 2.2
L601 1.0
C606 7.0
Q601 2N3563
Q602 2N3563
Q603 2N3563
C607 .5-3
C621 1.0
400 MHz
R610 330
R611 330
R612 330
R613 330
R614 56
X601 50 MHz
R601 4.7K
R605 560
C610 1000
C614 3
C615 .5-3
R608 3.9K
C620 .5-3
C608 27
R606 820
R607 3.9K
C623 1-6
C632 5
L607
C624 1-6
C633 5
L608
C625 1-6
C634 5
L609
C626 1-6
C635 5
L610
R603 39K
C603 1000
C611 1000
C616 1000
L602 10
L604 10
L606 10
C604 1000
C612 1000
C617 1000
-20V
-20V
J401 P801
L612
CR602 HPZ900
R615 56
R616 56
C648 .001μf
CR603 HPZ900
L613
J601
P601
R617 2.4K
C629 6.8μf
Q604 2N3563
C630 .1μf
P602
.05-100 MHz TO AMPLIFIER J701 (DWG 6104-700)
R634 3K
R618 2.2K
C631 6.8μf
-20V
400-500 MHz
LEVEL CONTROL VOLTAGE (DWG 610B-400)
6
NEGATIVE BLANKING PIN 17 (DWG 610B-100)
15
CONTROL VOLTAGE FROM PIN 17 (DWG 6104-800)
11
CW FILTER (DWG 610B-400)
12
CONTROL VOLTAGE FROM PIN 6 (DWG 6104-800)
J401 P801
+30V
C645 1000
C640 1000
R628 3K
C636 1000
R631 4.3K
R632 3K
C643 47
C644 47
C647 47
L626
L627
R626 10K
C638 47
Q625 2N3563
Q626 2N3563
Q627 2N3563
C637 3.3μf
L625
C639 .68
R627 5.6K
R629 2.7K
R630 3.9K
R633 2.7K
CR625 IN5139A
C641 1000
C642 1000
C646 1000
-20V

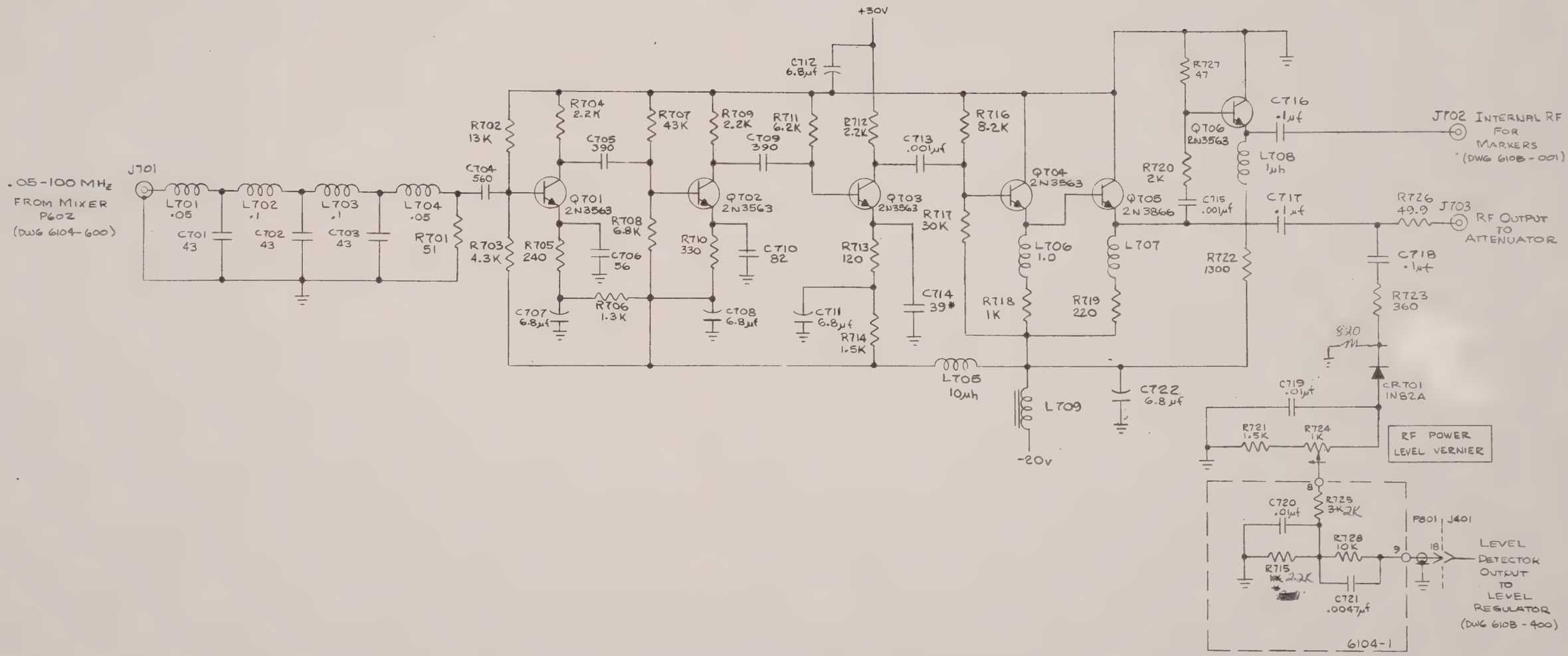
UNLESS OTHERWISE NOTED:
RESISTANCE IN OHMS
CAPACITANCE IN PICOFARADS
INDUCTANCE IN MICROHENRIES

400-500 MHz VOLTAGE CONTROLLED OSCILLATOR & AMPLIFIER

RF FREQUENCY GENERATOR

6104-600
8-28-67

RF FREQUENCY GENERATOR

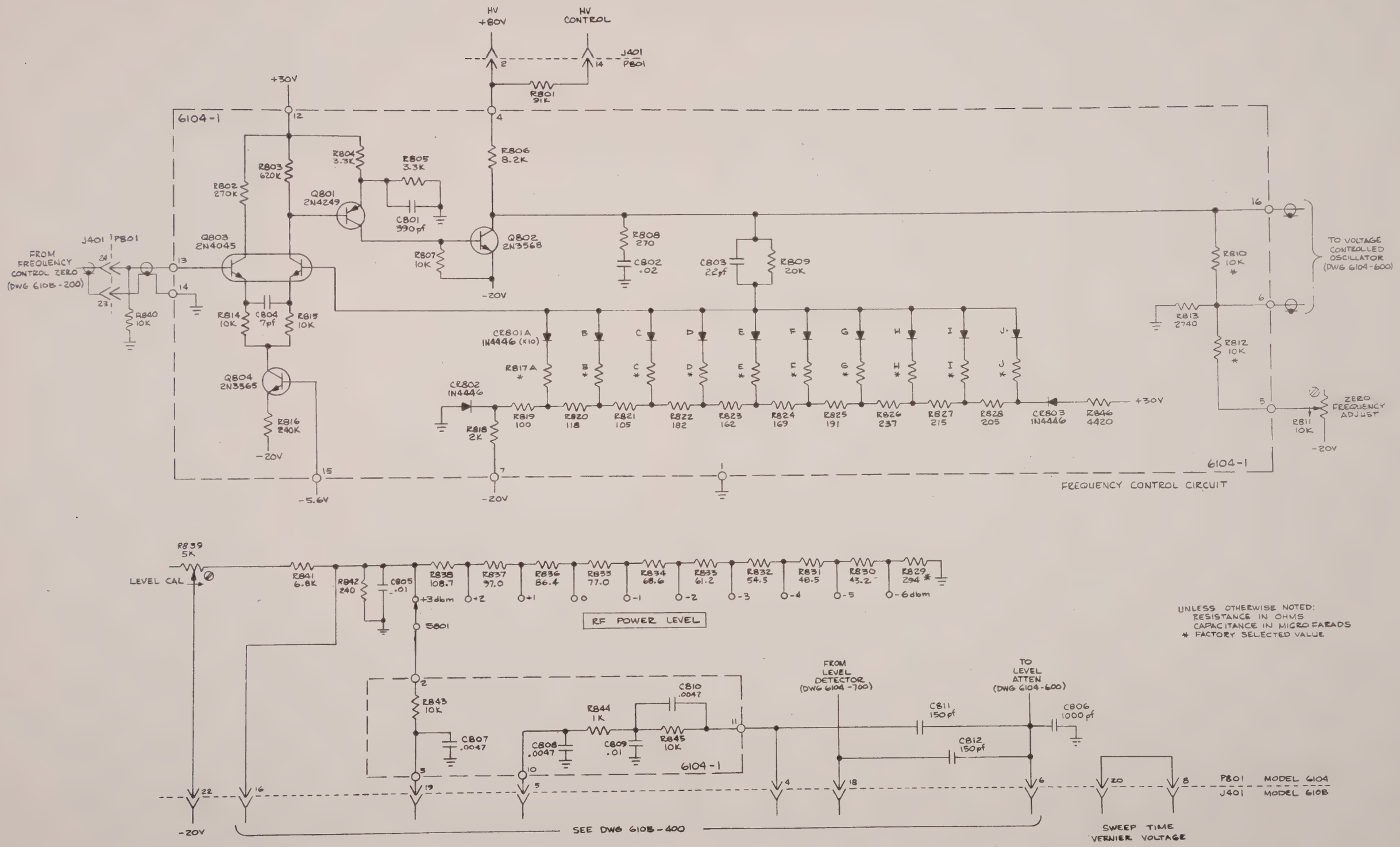


UNLESS OTHERWISE NOTED:
RESISTANCE IN OHMS
CAPACITANCE IN PICOFARADS
INDUCTANCE IN MICROHENRIES
* FACTORY SELECTED VALUE

POWER AMPLIFIER

6104-700
5-22-67

POWER AMPLIFIER



UNLESS OTHERWISE NOTED:
RESISTANCE IN OHMS
CAPACITANCE IN MICRO FARADS
* FACTORY SELECTED VALUE

FREQUENCY CONTROL AND RF POWER LEVEL

6104-800
5-22-67

FREQUENCY CONTROL AND RF POWER LEVEL

Resistors

R901	27K	1/4W	5%	Fixed	Comp
R902	2.2K	1/4W	5%	Fixed	Comp
R903	27K	1/4W	5%	Fixed	Comp
R904	4.3K	1/4W	5%	Fixed	Comp
R905	1K	1/4W	5%	Fixed	Comp
R906	100	1/4W	5%	Fixed	Comp
R907	3.3K	1/4W	5%	Fixed	Comp
R908	4.7K	1/4W	5%	Fixed	Comp
R909	4.7K	1/4W	5%	Fixed	Comp
R910	100	1/4W	5%	Fixed	Comp
R911	3.3K	1/4W	5%	Fixed	Comp
R912	470	1/4W	5%	Fixed	Comp
R913	470	1/4W	5%	Fixed	Comp
R914	1K	1/4W	5%	Fixed	Comp
R915	430	1/2W	5%	Fixed	Comp
R916	1K	1/4W	5%	Fixed	Comp
R917	47	1/8W	5%	Fixed	Comp
R919	30K	1/4W	5%	Fixed	Comp
R920	27K	1/4W	5%	Fixed	Comp
R921	2.2K	1/4W	5%	Fixed	Comp
R922	27K	1/4W	5%	Fixed	Comp
R923	4.3K	1/4W	5%	Fixed	Comp
R924	10K	1/4W	5%	Fixed	Comp
R925	10K	1/4W	5%	Fixed	Comp
R926	51	1/4W	5%	Fixed	Comp
R927	1K	1/4W	5%	Fixed	Comp
R928	39K	1/4W	5%	Fixed	Comp
R929	39K	1/4W	5%	Fixed	Comp
R930	390K	1/4W	5%	Fixed	Comp
R931	1.5M	1/4W	5%	Fixed	Comp
R951	4.7K	1/4W	5%	Fixed	Comp
R952	2.2K	1/4W	5%	Fixed	Comp
R953	150	1/4W	5%	Fixed	Comp
R954	33	1/4W	5%	Fixed	Comp
R955	2.2K	1/4W	5%	Fixed	Comp
R956	150	1/4W	5%	Fixed	Comp
R957	2.2K	1/4W	5%	Fixed	Comp
R958	4.7K	1/4W	5%	Fixed	Comp
R959	2.2K	1/4W	5%	Fixed	Comp
R960	100	1/4W	5%	Fixed	Comp

Capacitors

C901	5-60pf			Var	Mica
C902	180pf	500V	10%	Fixed	Mica
C903	1μf	35V	10%	Fixed	Tant
C904	39pf	500V	5%	Fixed	Mica
C905	1500pf	125V	5%	Fixed	Poly

Capacitors

C906	33pf	500V	5%	Fixed	Mica
C907	51pf	500V	5%	Fixed	Mica
C908	10pf	500V	5%	Fixed	Mica
C909	1μf	35V	10%	Fixed	Tant
C910	1000pf	500V	feed thru	Fixed	Ceram
C911	68pf	500V	feed thru	Fixed	Ceram
C912	1pf	500V	5%	Fixed	Ti02
C913	2-18pf	500V		Var	Mica
C914	1μf	35V	10%	Fixed	Taut
C915	7pf	500V	5%	Fixed	Mica
C916	43pf	500V	5%	Fixed	Mica
C917	15pf	500V	5%	Fixed	Mica
C918	1μf	35V	10%	Fixed	Tant
C919	2300pf	500V	feed thru	Fixed	Ceram
C920	2300pf	500V	feed thru	Fixed	Ceram
C921	2300pf	500V	feed thru	Fixed	Ceram
C922	2300pf	500V	feed thru	Fixed	Ceram
C923	2300pf	500V	feed thru	Fixed	Ceram
C924	51pf	500V	5%	Fixed	Mica
C925	150pf	500V	5%	Fixed	Mica
C951	.001μf	1KV	10%	Fixed	Ceram
C952	.001μf	1KV	10%	Fixed	Ceram
C953	2-20pf	1KV	10%	Var	Ceram
C954	.001μf	1KV	10%	Fixed	Ceram
C955	51pf	500V	5%	Fixed	Mica
C956	.68pf	500V	5%	Fixed	Ti02
C957	10pf	500V	5%	Fixed	Mica
C958	5pf	500V	10%	Fixed	Mica
C959	2-20pf	500V		Var	Ceram
C960	.001μf	1KV	10%	Fixed	Ceram
C961	.001μf	1KV	10%	Fixed	Ceram
C962	.001μf	1KV	10%	Fixed	Ceram

Transistors

Q901	2N3565	Q906	2N3563
Q902	2N3646	Q951	2N3563
Q903	2N3646	Q952	2N3563
Q904	2N3563	CR901	FDH600
Q905	2N3563	CR902	0114

Inductors

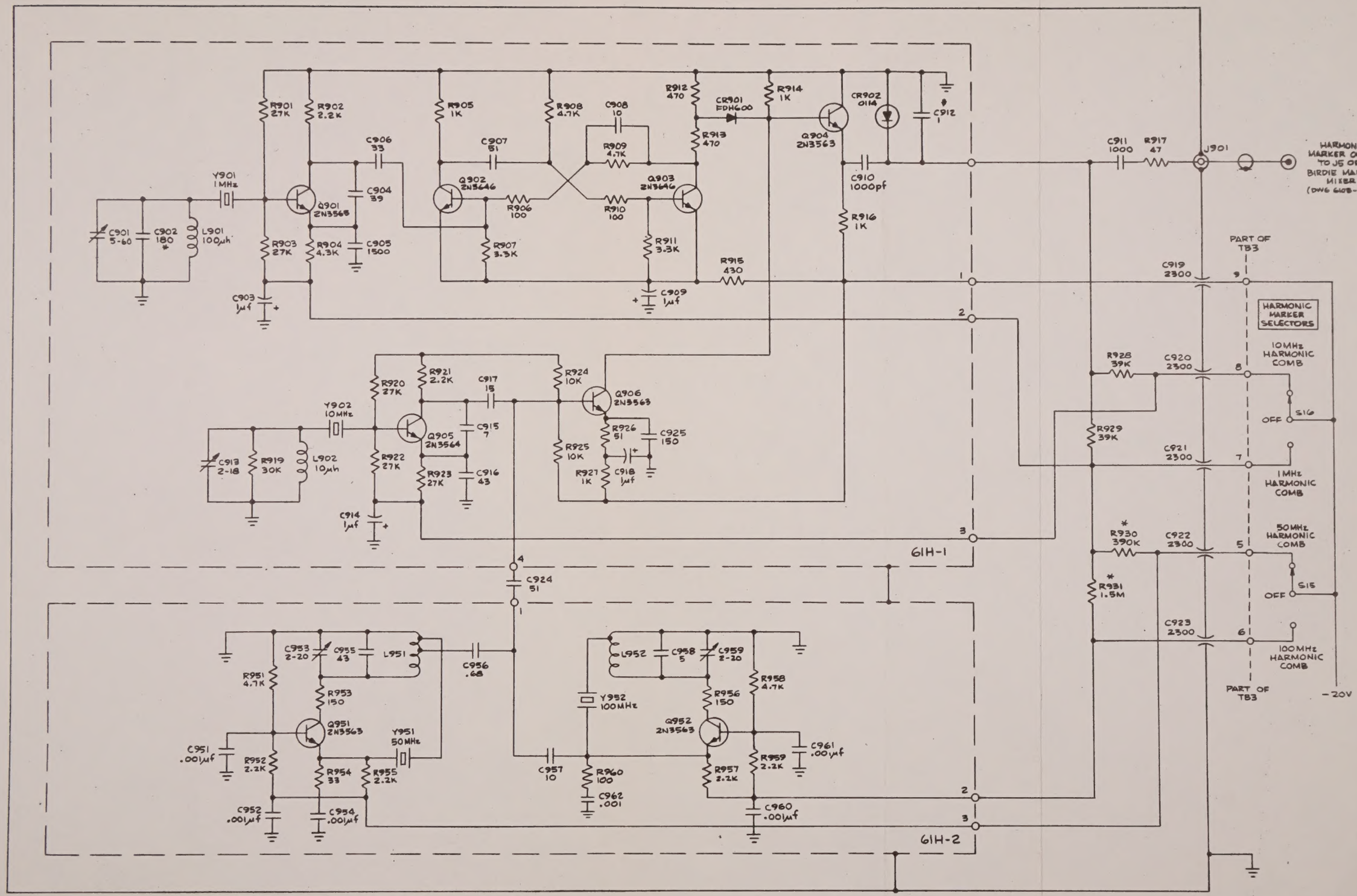
L901	100μh	Fixed	L951	Fixed
L902	10μh	Fixed	L953	Fixed

Crystals

Y901	1 MHz	Crystal	Y951	50 MHz	Crystal
Y902	10 MHz	Crystal	Y952	100 MHz	Crystal

Connectors

J901	MX-1684A/U



UNLESS OTHERWISE NOTED:
RESISTANCE IN OHMS
CAPACITANCE IN PICOFARADS
* FACTORY SELECTED VALUE

PRINT: 9-68

1, 10, 50 & 100 MHz HARMONIC MARKER GENERATOR MODEL 61HH

610B-950HH
7-16-68

1, 10, 50 & 100 MHz HARMONIC MARKER GENERATOR MODEL 61HH

MP MASTER
MA34180